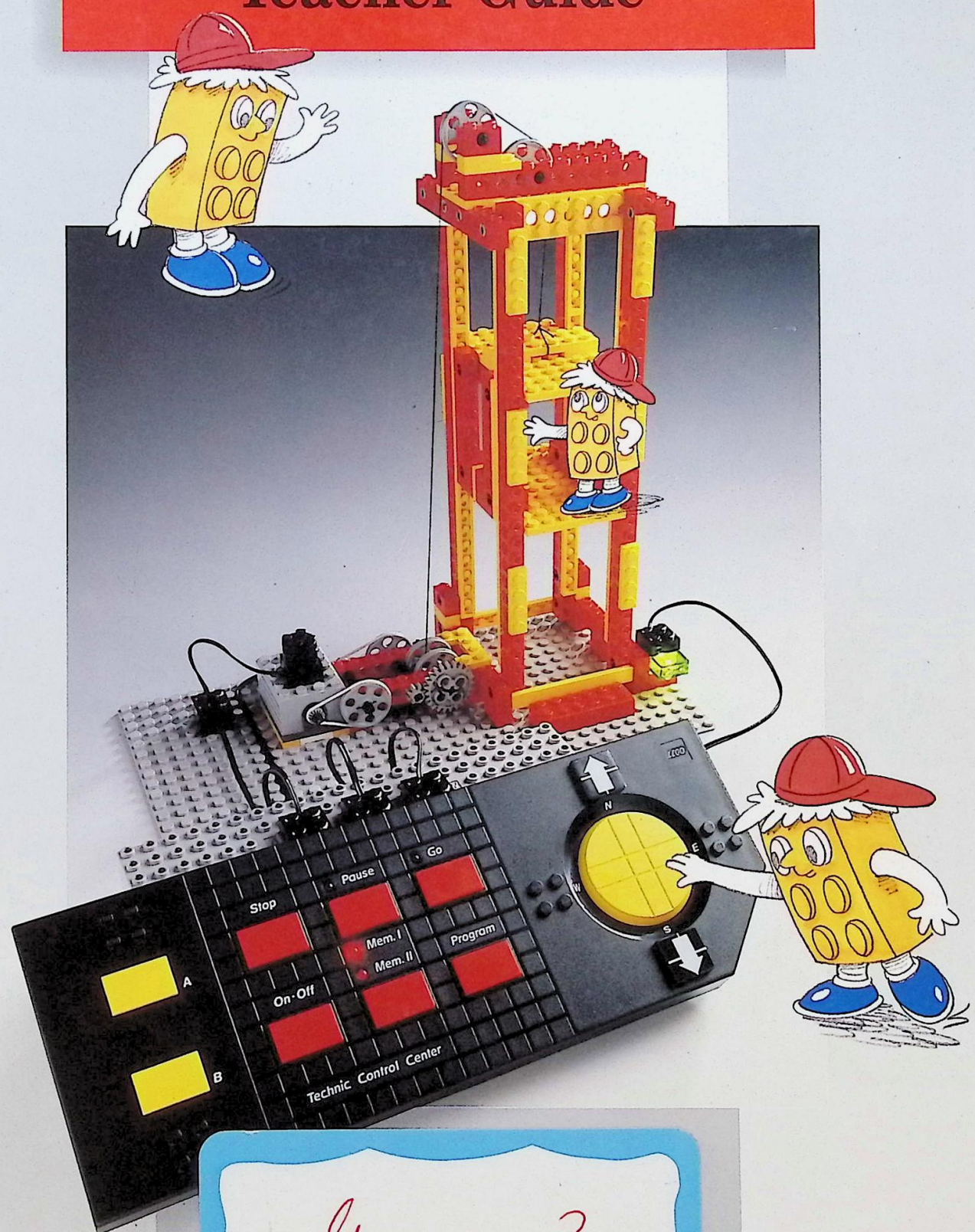
LEGO DACTA®
Simple Control Activity Pack
Teacher Guide



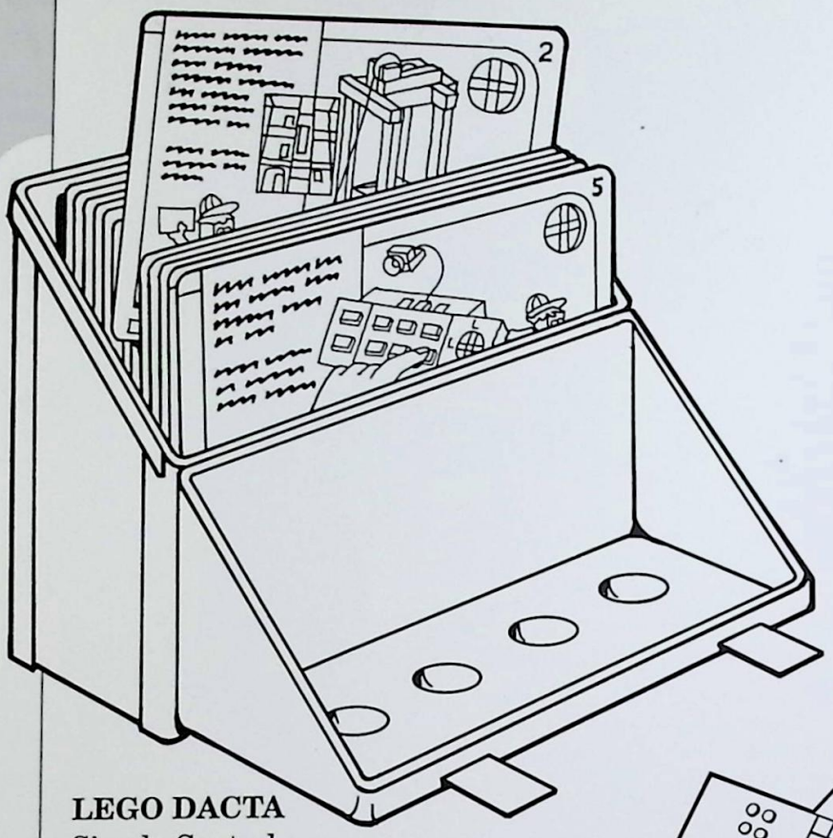
Grade 3
pre-computer
control

lego dacta

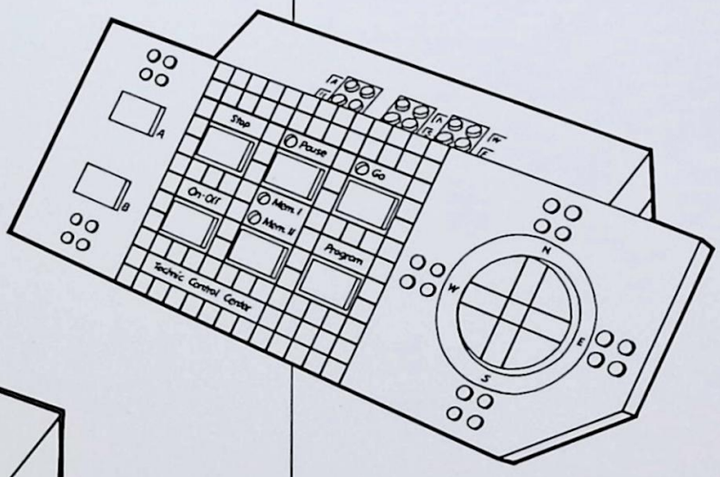
9703

Overview

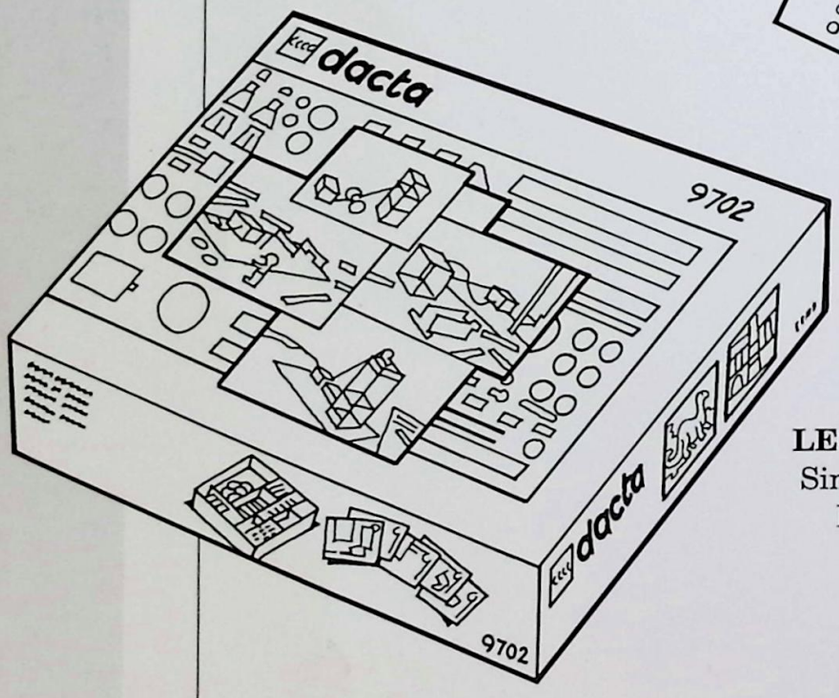
The LEGO DACTA® Simple Control Activity Pack (item #9703) consists of this teacher guide and the accompanying activity cards. The pack is designed for use with the TECHNIC Control Center (item #9753) and the LEGO DACTA Simple Control Building Set (item #9702).



LEGO DACTA
Simple Control
Activity Pack
Item #9703



TECHNIC
Control Center
Item #9753



LEGO DACTA
Simple Control
Building Set
Item #9702

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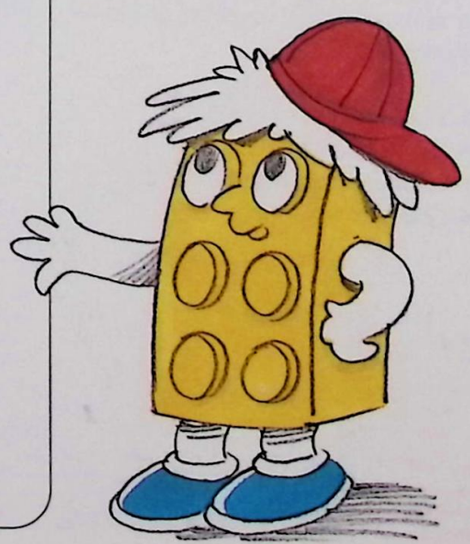


Introduction

The LEGO DACTA Simple Control Activity Pack (item #9703) is designed for use with the TECHNIC Control Center (item #9753) and the LEGO DACTA Simple Control Building Set (item #9702). The activity pack consists of:

- 44-page teacher guide
- 5 green exploration activity cards
- 4 blue investigation activity cards
- 9 red problem solving activity cards
- 3 sorting index cards

With these materials, you will be able to introduce your students to the fundamentals of motorized machines and control technology in a problem solving context.

Curriculum Areas

The LEGO DACTA Simple Control Activity Pack contains activities to supplement regular classroom instruction in many different subject areas, including:

- Physical science
  - simple machines
  - motion
  - work, power, energy
  - electricity
- Technology
  - construction
  - communication
  - transportation
  - program control
- Fine Arts
  - theater
  - kinetic art

These activities also promote development of several other important skills, including those related to:

- Problem solving
- Critical thinking
- Science process
- Cooperative learning

Curriculum Model

LEGO Dacta, the educational division of LEGO Systems, Inc., has established a curriculum model based on widely accepted theories of learning. The model is based on three types of activities.

- **Exploration.** Students become familiar with building materials and concepts to be learned in an informal manner. They learn how the various building elements function and lay the foundation for more formal learning. Exploration activities are coded in green.

- **Investigation.** Students learn important concepts in a more structured and formal setting, often following step-by-step instructions to build models. They investigate the behavior and function of their models and develop a fuller understanding of the related scientific principles. Investigation activities are coded in blue.

- **Application.** Problem solving challenges offer students the opportunity to apply what they have learned. Students invent machines and devices of their own design to solve problems similar to those in the real world. They evaluate their solutions and revise their inventions accordingly. Application or problem solving activities are red-coded.

Instructional materials based on this curriculum model provide teachers with choices when preparing for classroom activities. A teacher who is comfortable with a sequential approach to instruction can use the green, blue and red activity cards in sequence effectively. A teacher who has a more open-ended approach to instruction can select from among the various types of activities to suit the learning styles of particular student groups.

Problem Solving

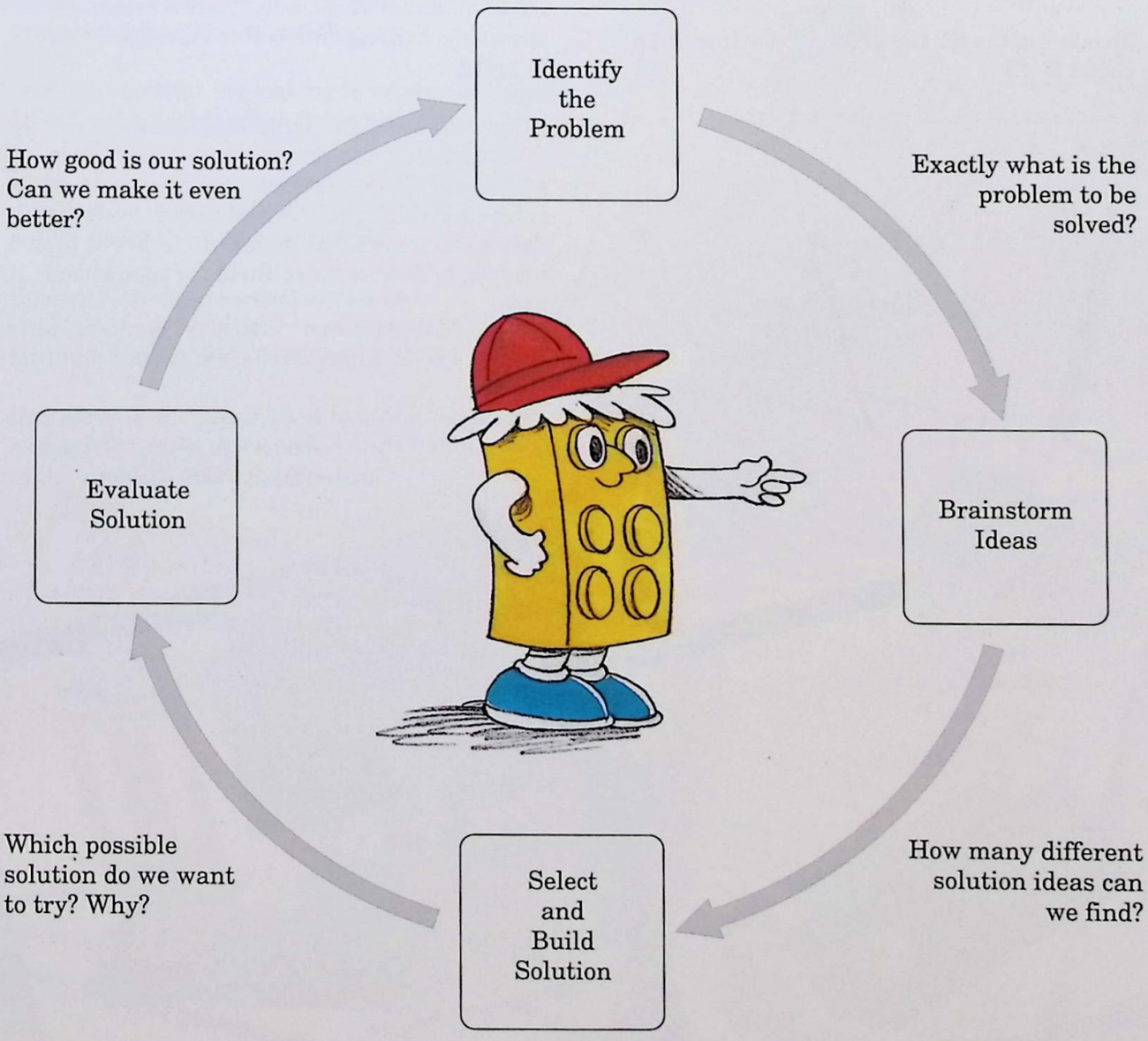
The LEGO DACTA Simple Control Activity Pack is especially well suited for developing hands-on problem solving skills among elementary school students. There are several advantages to a hands-on method.

1. Hands-on problem solving activities give students a better understanding of process. In working on the actual problem solving device, students come into personal contact with processes of design and scientific investigation.

2. Hands-on activities provide the all-important context and motivation for problem solving. Students come into contact with new ideas as a natural part of the activity.

3. Hands-on activities provide a flexible approach to accommodate many different learning styles. Tactile learners can work successfully alongside visual learners, for example.

Although there are many different problem solving methods practiced in schools, most of them can be reduced to four steps, as shown in the figure below. Effective instructional planning provides students with opportunities to work on all four steps. Encourage your students to develop their own problem solving skills and strategies as they rise to the challenges of the LEGO DACTA Simple Control Activity Pack.


Identify the Problem
Exactly what is the problem to be solved?
Brainstorm Ideas
How many different solution ideas can we find?
Select and Build Solution
Which possible solution do we want to try? Why?
Evaluate Solution
How good is our solution? Can we make it even better?

Overview of the Activity Cards

Green Cards

Exploration activities are supported by the five green cards. They are designed to familiarize students with the TECHNIC Control Center and to introduce the building materials and how they work. As students progress through the cards in order, they learn how to:

- Install and check the batteries.
- Use the yellow control buttons and the yellow control pad.
- Connect and operate the sound element, lamp and motor.
- Create and run a simple program.
- Include pauses in a simple program.
- Use a Program Sheet to plan and record a program.

Teacher notes for the green cards appear on pages 9–13.

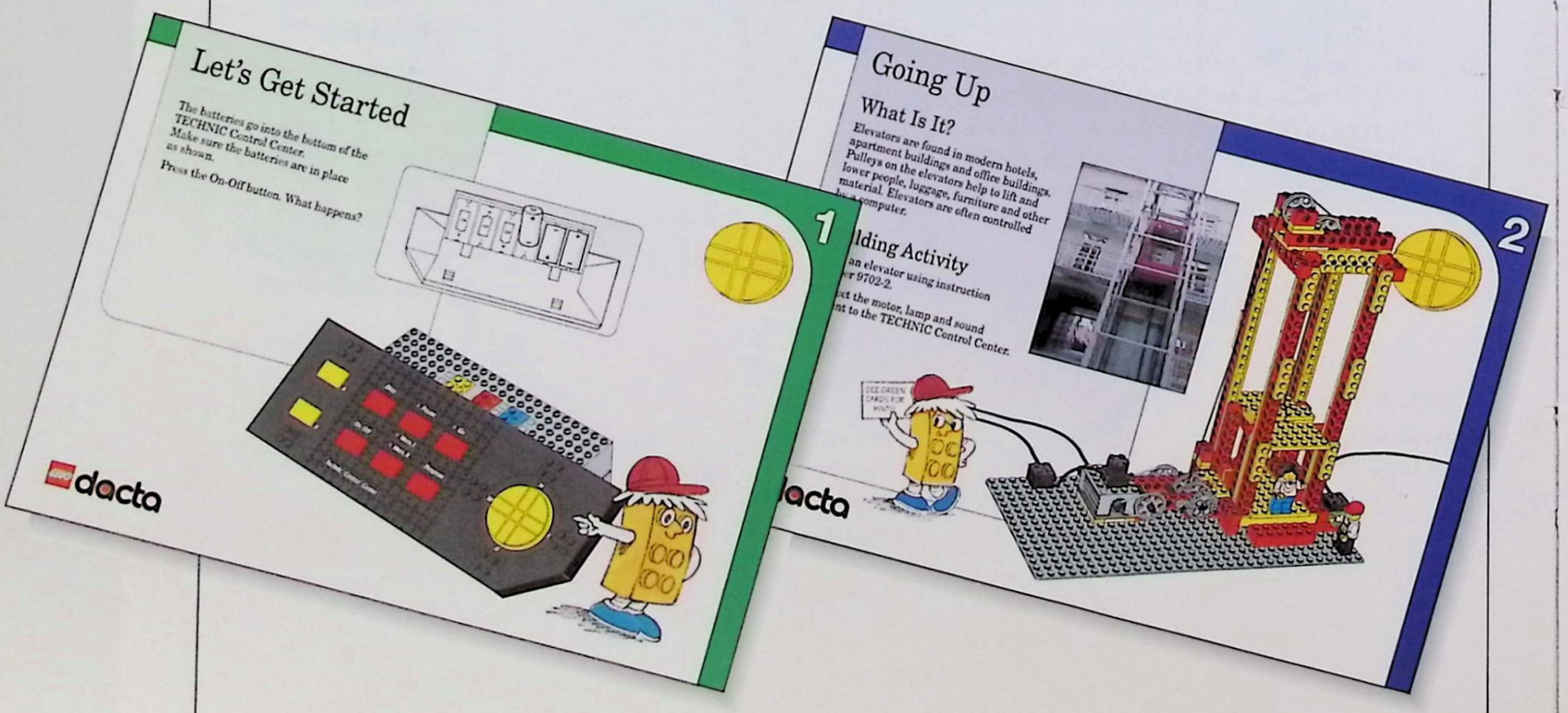
Blue Cards

Investigation activities are promoted by the four blue cards. Based on step-by-step building instructions from the LEGO DACTA Simple Control Building Set, students construct motorized models and then operate them to learn how they function.

Students then perform simple investigations with the models and create simple programs in response to programming challenges. Students can record their programs on Program Sheets made from the copy master on page 41.

The models are based on actual machines and devices, and provide an important link to the real world. The teacher notes on pages 14–17 include "What Is It?" information to stimulate a discussion before students begin to build.

After students have completed their investigations and programming, give them additional opportunities to tell how their model is like something in the real world. Perhaps they have some ideas on how to improve their models, or to customize them for specialized uses.


Let's Get Started
The batteries go into the bottom of the TECHNIC Control Center.
Make sure the batteries are in place as shown.
Press the On-Off button. What happens?
1
dacta
Going Up
What Is It?
Elevators are found in modern hotels, apartment buildings and office buildings. Pulleys on the elevators help to lift and lower people, luggage, furniture and other material. Elevators are often controlled by a computer.
lding Activity
an elevator using instruction r 9702-2.
ct the motor, lamp and sound nt to the TECHNIC Control Center.
2
dacta

Red Cards

Problem solving applications are presented by the nine red cards. Each card shows a problem situation on the front, along with descriptive text, to help students identify the problem clearly. On the back of each card are more detailed challenges, along with suggestions on how to test the solutions. This sequence follows the figure on page 5.

Students need sufficient time to think of a number of solutions to a problem. One technique used successfully by teachers is to give students photocopies of the front of a red card several days before the building activity is scheduled. They also provide opportunities for student groups to meet and discuss the problem situation in advance. This helps students to be prepared for action on building day.

Teacher notes for the red cards appear on pages 18–26, and include ideas for extensions.

Make sure students understand the importance of evaluating their solutions and revising them as appropriate.

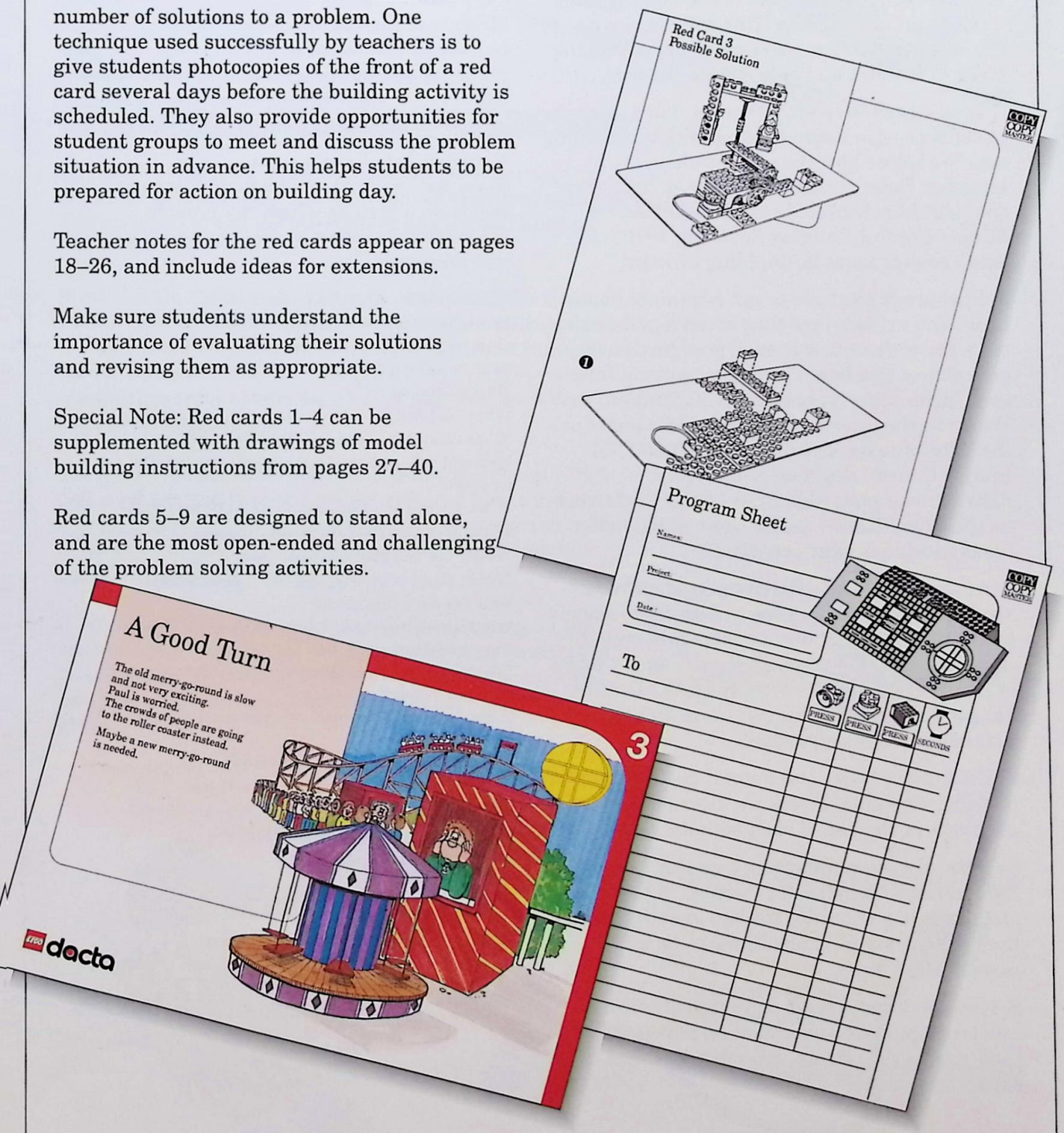
Special Note: Red cards 1–4 can be supplemented with drawings of model building instructions from pages 27–40.

Red cards 5–9 are designed to stand alone, and are the most open-ended and challenging of the problem solving activities.

Program Sheets

The Program Sheet is introduced in green cards 4 and 5, and gives students a way to record their programs. They use the sheet for planning a program in advance, or for documenting their program after they are satisfied with how it functions.

The Program Sheet copy master appears on page 41.



Teaching Tips

Teaching Tips

Listed below is a collection of tips and hints from teachers who use LEGO® materials enthusiastically in their everyday instruction.

1. Assign students to groups of 2 or 3 for the activities. Suggest that they each play a different role, and that the roles be switched regularly.

2. Mark each building set with a number so that the same building set is used by the same student group each day. This will also invite the students to be more responsible in keeping track of the building elements in the sets.

3. If students have little or no building experience, give them free time with the building sets to explore how the various elements fit together. Refer students to the middle pages of the light blue booklet in the LEGO DACTA Simple Control Building Set (item #9702) for small project ideas for building practice.

4. Encourage students to get acquainted with gears and explore how they mesh together and turn. Show them how a small gear turns a larger gear slowly, and how a large gear turns a smaller gear faster. Several gearing configurations are shown in the drawings on the middle pages of the light blue booklet in the LEGO DACTA Simple Control Building Set. (Other instructional materials from LEGO Dacta such as the Gear Teacher Guide (item #9620) offer ideas for simple gear activities.)

5. At the end of each activity period, provide students with enough time to take their models apart and store all building elements properly in the building set trays. Refer to pages 2 and 3 of the light blue booklet in the LEGO DACTA Simple Control Building Set (item #9702) for detailed storage suggestions.

6. Establish a "Lost and Found" cup for stray building elements. Check the floor for building elements at the end of each activity period.

7. If the situation warrants, consider keeping the electrical components (motors, lamps, sound elements) in a separate storage area. Sign out the components to student groups on an as-requested basis.

8. Have on hand a large collection of other construction material, including paper, straws, tape, cardboard, string, pipe cleaners, and paper clips.

Assessment

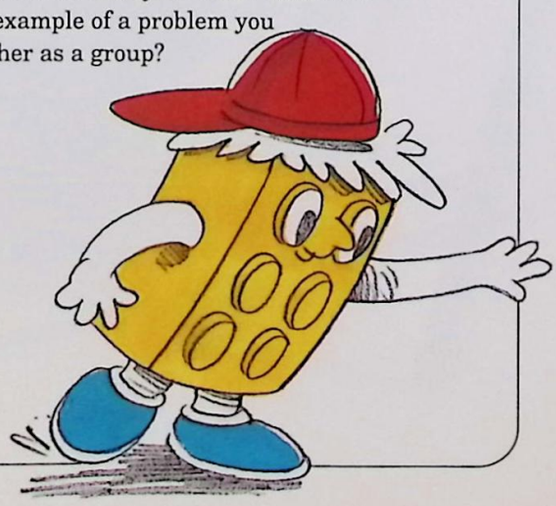
Assessment is an important part of every educational activity. Teachers must assess the progress of each learner. Teachers also help learners to become effective in self-assessment.

Assessment takes many forms, including written tests, check lists, portfolios, interviews, and projects. Use a variety of assessment means for a complete picture of a student's progress and abilities.

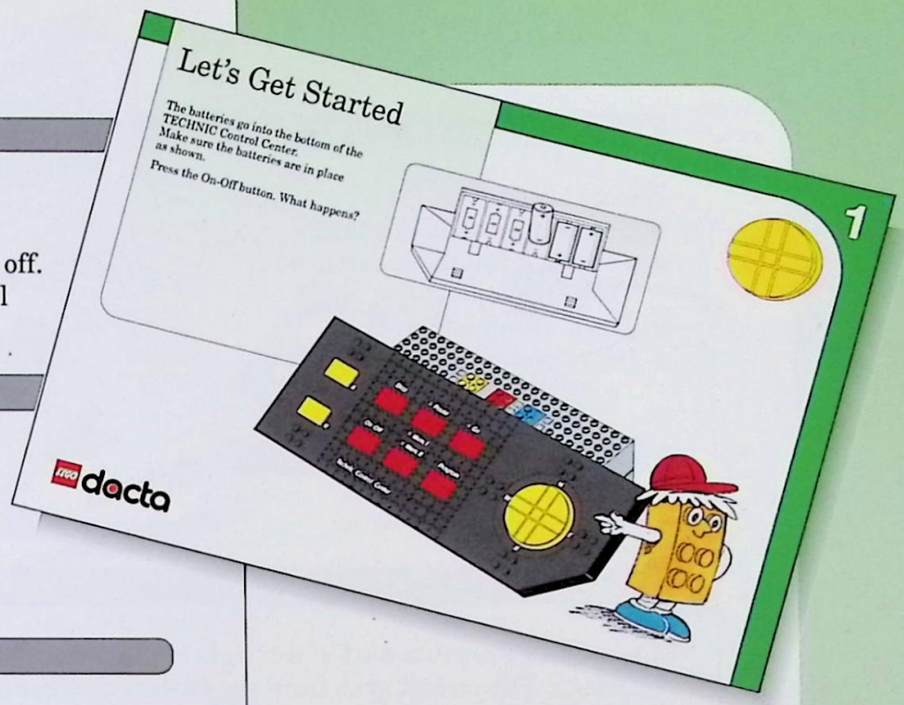
Many teachers ask students to keep an individual journal in which they describe their planning and building activities, tell what was easiest and most difficult about their projects, and how they solved their problems.

Here is a list of questions to use in conversations with students during their hands-on activities which can provide information on their understanding of concepts and processes.

What problem are you trying to solve?
Does this relate to anything in the real world?
Could you please show me and tell me how your model works?
How do you use it?
What will it do?
What other ideas did you have for solutions?
How did you and your team members pick this solution?
What special building elements have you used?
What does this gear do in your model?
Where are the gears in your model?
Which parts of your model move the fastest?
How far does this move?
What questions have you thought about as you were building?
What roles did your team members play as you all were building?
What part of this project are you most curious about?
Does it work well enough to satisfy you?
How could this be improved even more?
What did you learn from your team members?
What is an example of a problem you solved together as a group?



Let's Get Started


Let's Get Started
The batteries go into the bottom of the TECHNIC Control Center. Make sure the batteries are in place as shown.
Press the On-Off button. What happens?
1
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Objectives

Enable students to:

- Install batteries correctly.
- Turn the TECHNIC Control Center on and off.
- Become familiar with buttons and electrical elements.

Key Words

battery
circuit
lamp
motor
sound element
conducting plate
connecting lead
negative
positive

Notes

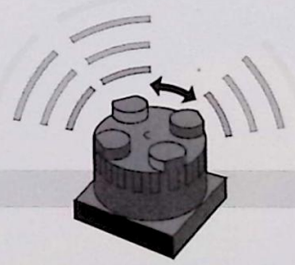
The six "C" batteries must be placed in alternating order as shown to form this part of the circuit, or electrical pathway. The positive (+) end of each battery has a small knob or bump. The negative (-) end is flat.

Press the On-Off button to turn on the TECHNIC Control Center. You should see the red Mem. I light, indicating that the unit is on. (If you cannot see the red Mem. I light, check the batteries to make sure they are in the correct alternating order.) Press the On-Off button a second time to turn the unit off.

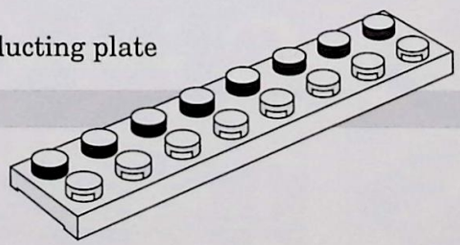
The yellow buttons marked A and B and the round yellow pad send electricity to the yellow, red, and blue terminals. Unless a motor, lamp or sound element is connected to one of these terminals, nothing will happen when students press the yellow buttons or pad.

If students press other red buttons after turning on the control center, additional red lights may turn on or begin flashing. The remaining green cards help them explore how the yellow buttons, the round pad, and the other red buttons work.

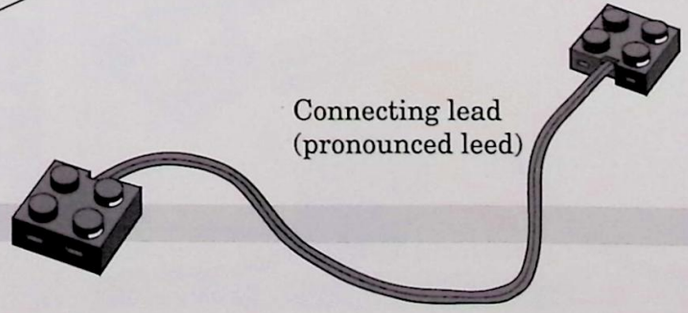
Sound element



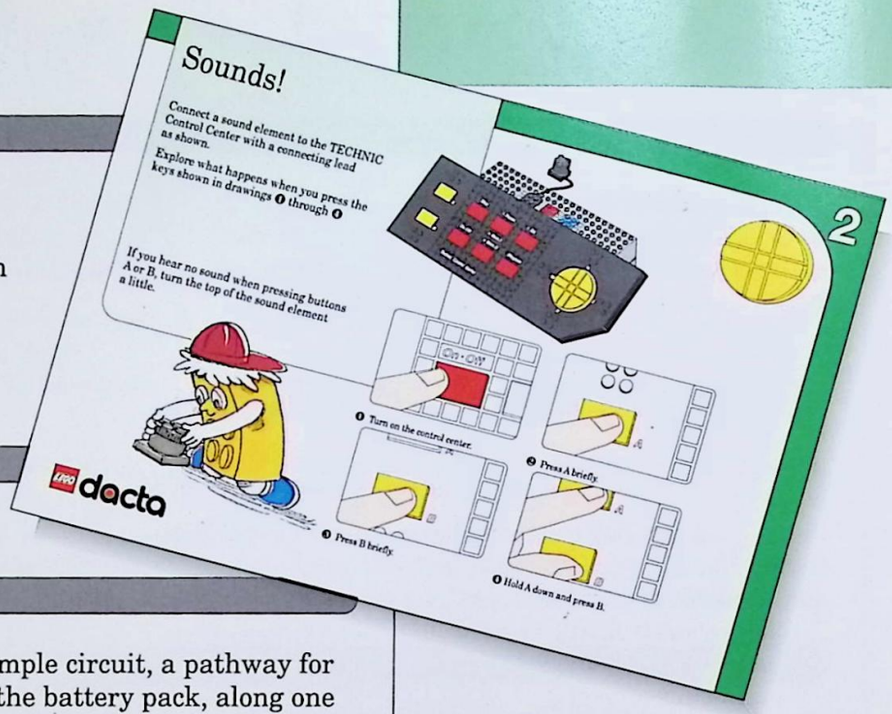
Conducting plate



Connecting lead
(pronounced leed)



Sounds!


Sounds!
Connect a sound element to the TECHNIC Control Center with a connecting lead as shown.
Explore what happens when you press the keys shown in drawings ❶ through ❹
If you hear no sound when pressing buttons A or B, turn the top of the sound element a little.
2
❶ Turn on the control center.
❷ Press A briefly.
❸ Press B briefly.
❹ Hold A down and press B.
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Objectives

Enable students to:

- Connect a sound element.
- Control a sound elements with the yellow buttons.
- Trace a simple circuit.
- Learn that electricity has a direction.

Key Words

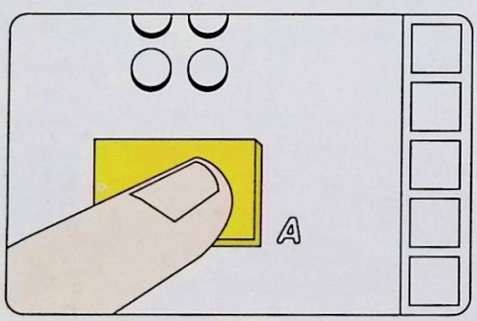
circuit sound wire

Notes

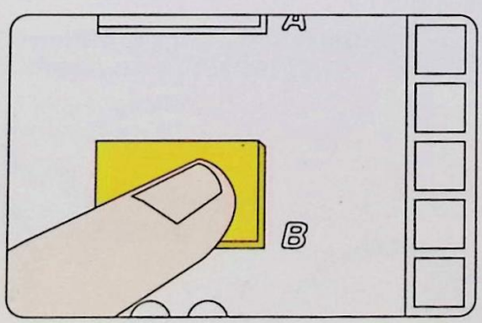
The sound element is part of a simple circuit, a pathway for electricity. The circuit goes from the battery pack, along one of the wires in the connecting lead, through the sound element, and back to the battery back through the other wire in the connecting lead.
Electricity flows through the circuit when button A is pushed, producing a sound. When button B is pushed, electricity flows in the opposite direction, producing a different sound.
To operate the sound element continuously, hold down one yellow button and press the other one briefly. To stop, press either yellow button or the red Stop button.
If no sound is produced, turn the top of the sound element a quarter turn and try again.

Yellow buttons A and B control the sound element (or lamp or motor) clipped to the yellow connector. The yellow buttons send electricity through the circuit in different directions.

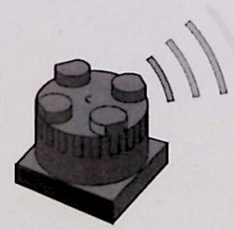
The direction of electricity makes no difference in the operation of a lamp. However, reversing the direction of electricity to a motor reverses the direction of rotation.



Listen to the sound element when you push button A.



Listen to the different sound when you push button B.



Two Together

Objectives

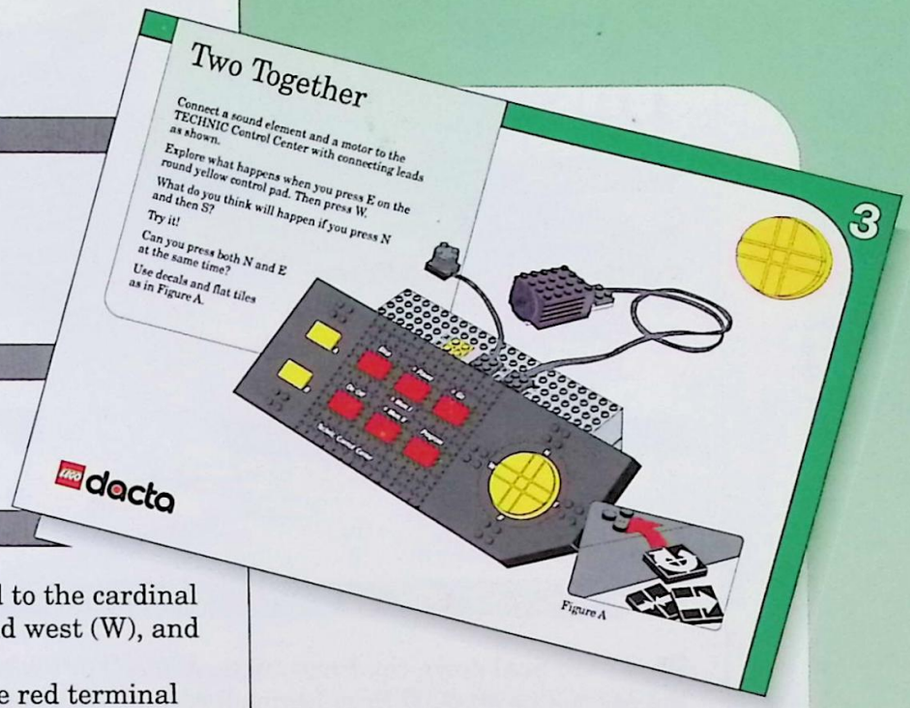
Enable students to:
- Use the yellow pad.
- Operate two devices at once.
- Review cardinal directions.

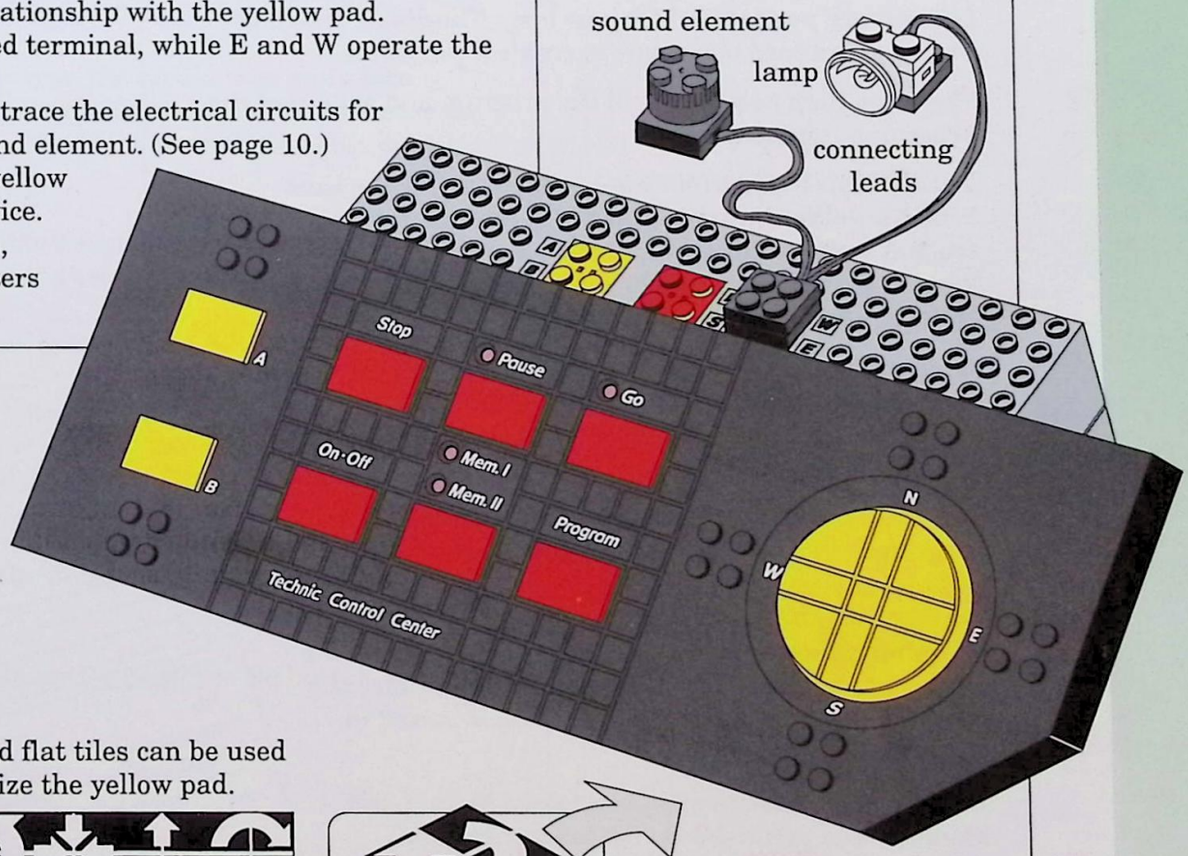
Key Words

circuit	east (E)	south (S)
pad	north (N)	west (W)

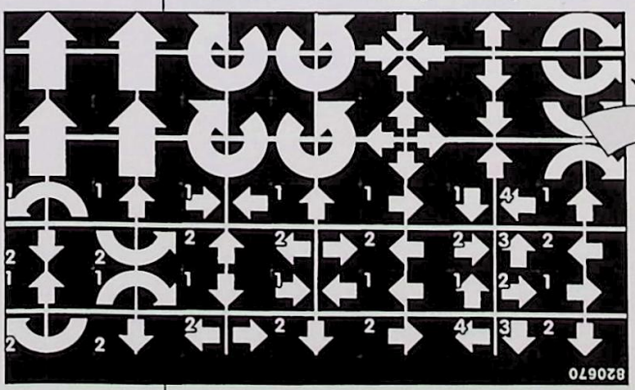
Notes

The letters around the yellow pad correspond to the cardinal directions of north (N), east (E), south (S), and west (W), and are arranged in the same order as on a map.
Show students the N and S letters next to the red terminal and the E and W letters next to the blue terminal to help them see the direct relationship with the yellow pad.
N and S operate the red terminal, while E and W operate the blue terminal.
Challenge students to trace the electrical circuits for the motor and the sound element. (See page 10.)
Press the edge of the yellow pad to operate one device.
To operate two devices, press between two letters on the pad.

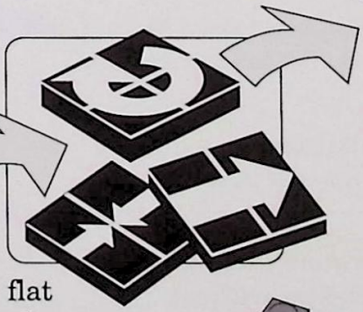

Two Together
Connect a sound element and a motor to the TECHNIC Control Center with connecting leads as shown.
Explore what happens when you press E on the round yellow control pad. Then press W.
What do you think will happen if you press N and then S?
Try it!
Can you press both N and E at the same time?
Use decals and flat tiles as in Figure A.
3
dacta
Figure A



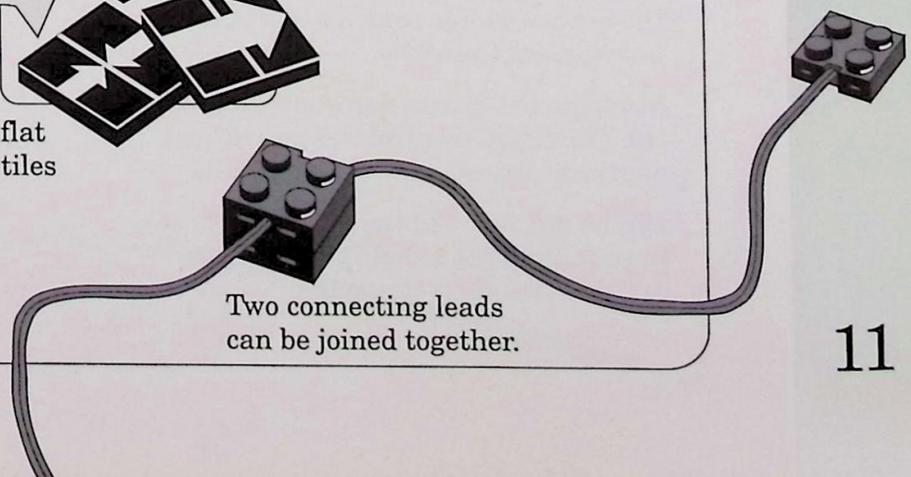
Decals and flat tiles can be used to customize the yellow pad.



decals

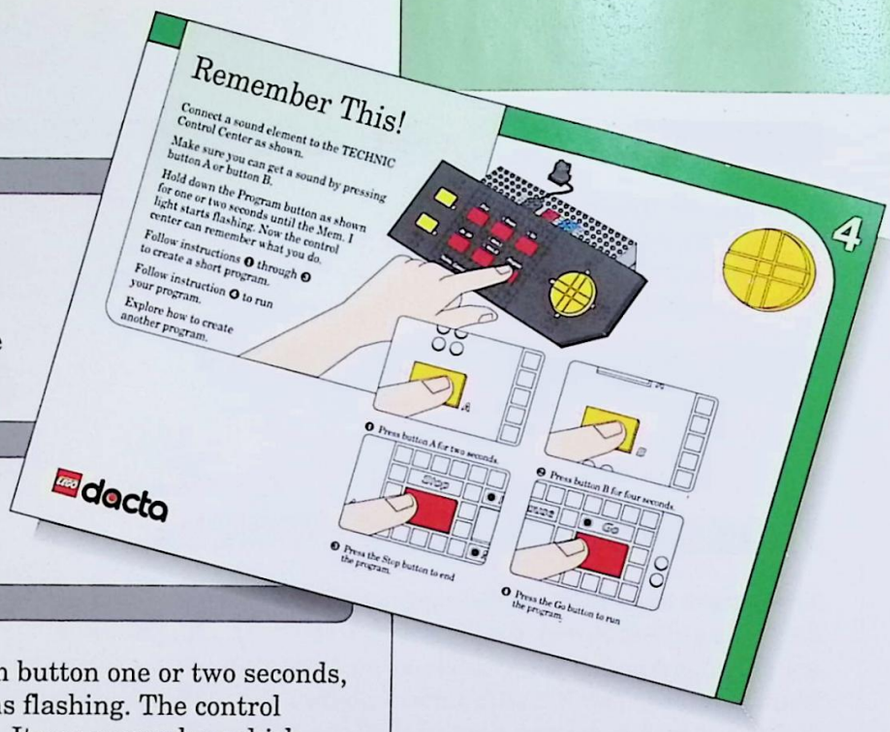


flat tiles



Two connecting leads can be joined together.

Remember This!


Remember This!
Connect a sound element to the TECHNIC Control Center as shown.
Make sure you can get a sound by pressing button A or button B.
Hold down the Program button as shown for one or two seconds until the Mem. I light starts flashing. Now the control center can remember what you do.
Follow instructions ❶ through ❸ to create a short program.
Follow instruction ❹ to run your program.
Explore how to create another program.
4
❶ Press button A for two seconds.
❷ Press button B for four seconds.
❸ Press the Stop button to end the program.
❹ Press the Go button to run the program.
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Objectives

Enable students to:

- Create and run a program.
- Run a program continuously.
- Use a Program Sheet to create or record a program.

Key Words

duration
program
memory
sequence

Notes

When you hold down the Program button one or two seconds, the Mem. I or Mem. II light begins flashing. The control center is in a programming mode. It can remember which buttons are pushed and for how long. The small drawings on the green card show how to create a program.

Press the Stop button to end the program and get out of the programming mode.

The TECHNIC Control Center cannot detect the time between yellow button pushes. For example, even if a student waits a full minute between instruction (1) and instruction (2) on the green card, there will be no interval between the two instructions when the program runs.

A program remains in memory until replaced by another program or until the batteries are removed. Even if the control center is turned off with the On-Off button, the program remains in memory.

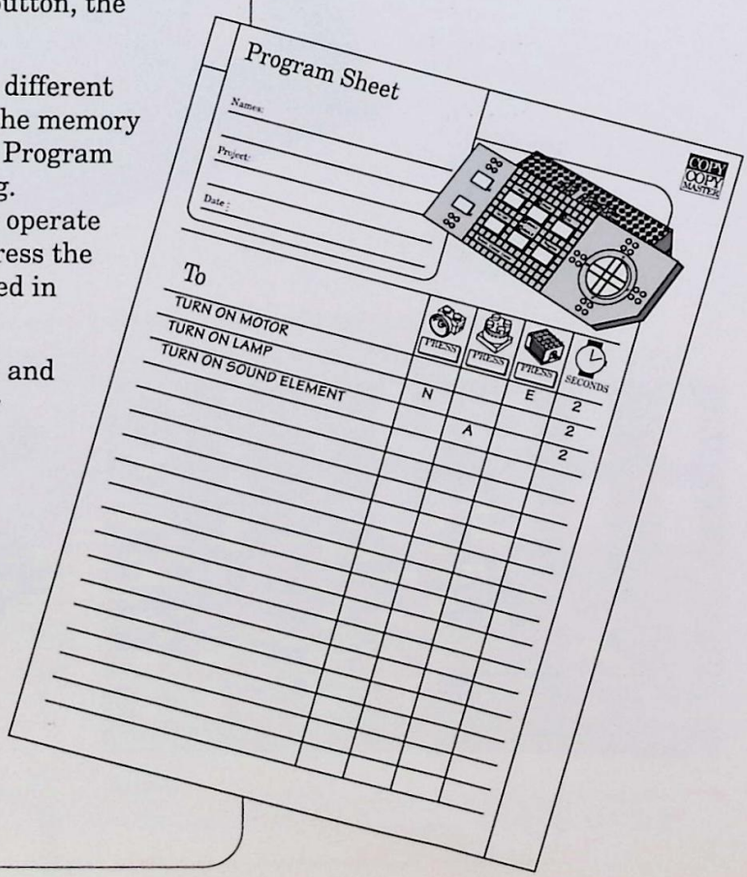
The TECHNIC Control Center can store two different programs. To store a second program, press the memory button to select Mem. II, then hold down the Program button until the Mem. II light begins flashing. Press the yellow buttons or the yellow pad to operate anything connected to the terminals. Then press the red Stop button. Your second program is stored in Mem. II.

Use the red button to switch between Mem. I and Mem. II, and press the Go button to run your programs.

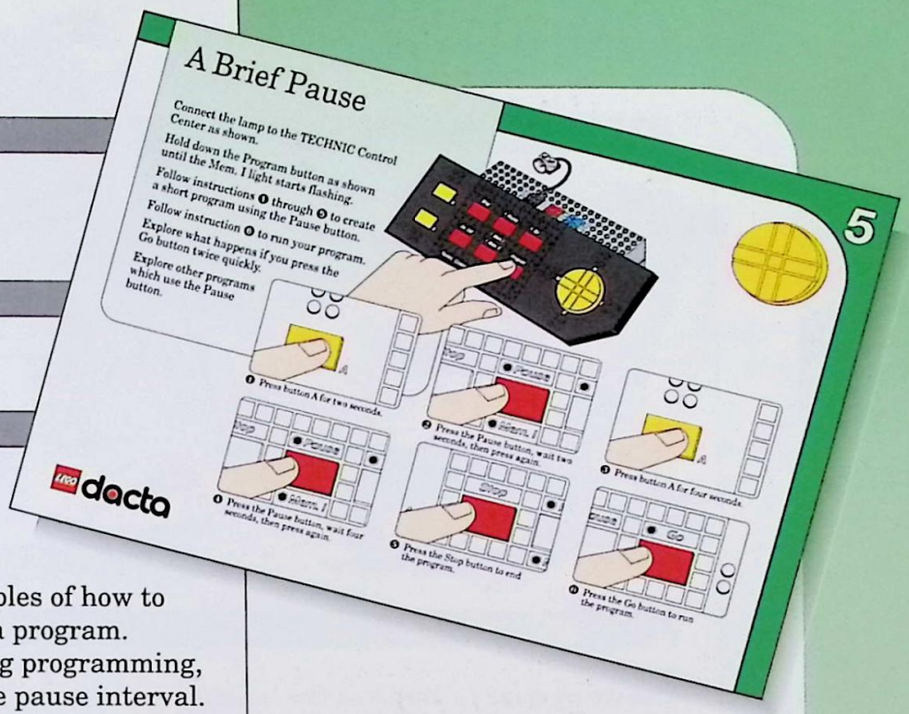
When you press the Go button twice quickly, the control center runs the selected program continuously.

Students can create and store programs in the TECHNIC Control Center without anything connected to the terminals.

Distribute copies of the Program Sheet to your students to help them design and describe their programs.



A Brief Pause


A Brief Pause
Connect the lamp to the TECHNIC Control Center as shown.
Hold down the Program button as shown until the Mem. 1 light starts flashing.
Follow instructions ❶ through ❺ to create a short program using the Pause button.
Follow instruction ❻ to run your program.
Explore what happens if you press the Go button twice quickly.
Explore other programs which use the Pause button.
5
lego dacta

Objectives

Enable students to:

- Pause in a program.

Key Words

interval pause vehicle

Notes

The Pause button inserts intervals of time into programs.

Instructions (2) and (4) on the card are examples of how to insert intervals of two and four seconds into a program. When the Pause button is pressed once during programming, the red light comes on to show the start of the pause interval. To finish the pause, press the Pause button once more. The red light goes off, marking the end of the pause interval.

The simple vehicle shown on the card moves quite fast. Students should be prepared either to turn on the motor for short intervals of time or to follow the vehicle while carrying the control center.

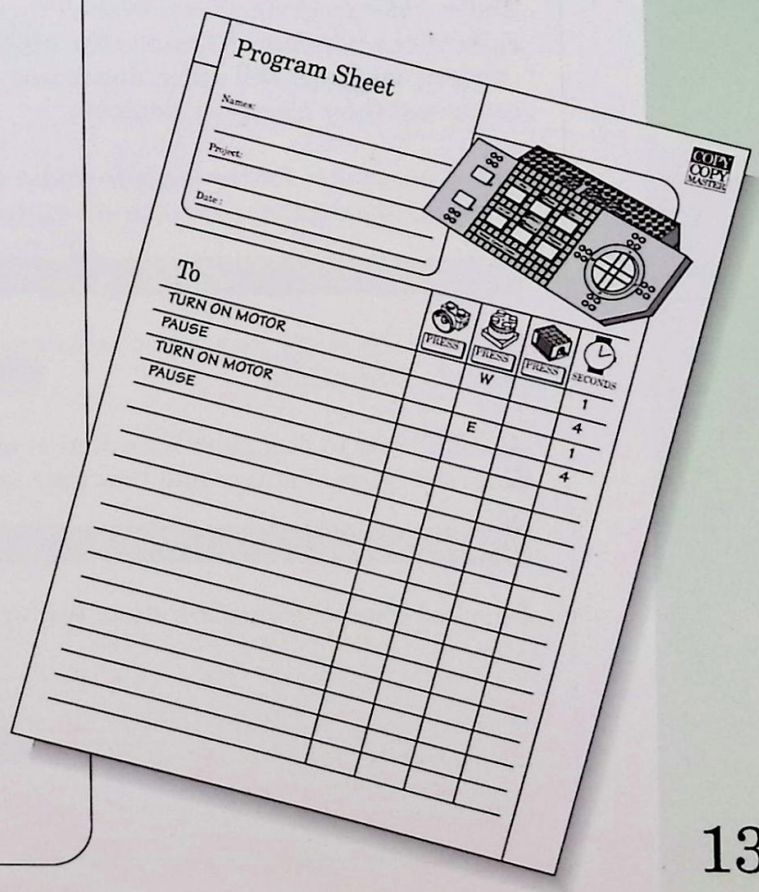
Provide photocopies of the Program Sheet for students to use in designing and describing their programs.

Other pause techniques include:

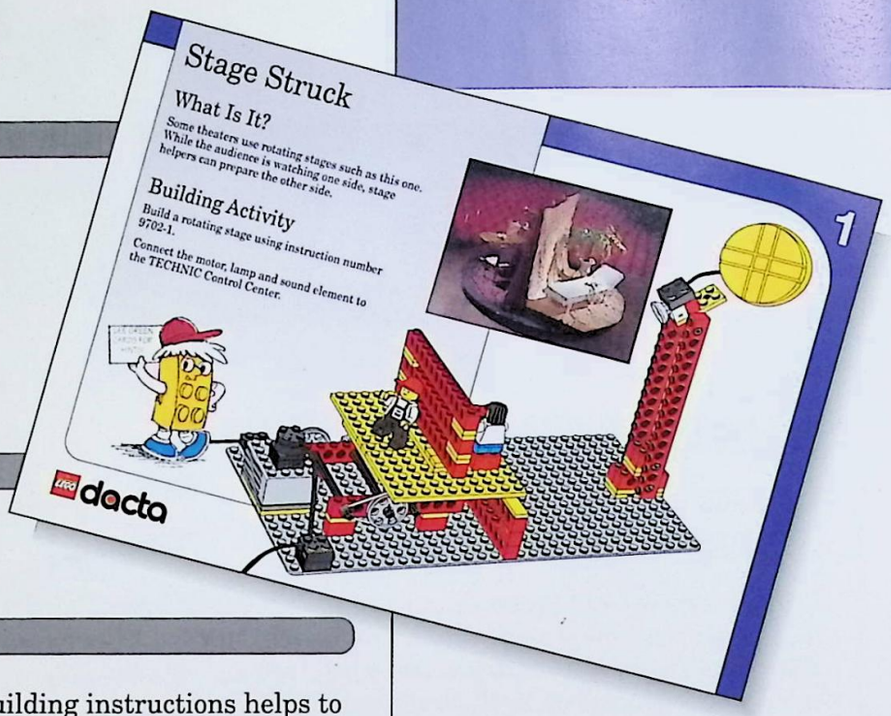
1. Start a program by pressing the Pause button once. Then push the desired yellow buttons or pad positions. Pauses are inserted automatically between pushes.

2. When a program is running, you can push the Pause button. This will stop the program until you push the Go button.

To run a program continuously, push the Go button twice quickly.



Stage Struck


Stage Struck
What Is It?
Some theaters use rotating stages such as this one. While the audience is watching one side, stage helpers can prepare the other side.
Building Activity
Build a rotating stage using instruction number 9702-1.
Connect the motor, lamp and sound element to the TECHNIC Control Center.
1
dacta

Objectives

Enable students to:

- Follow instructions to build a model of a rotating stage.
- Measure the time it takes the stage to rotate.
- Create a program to control the rotating stage.

Key Words

pulley wheel
spur gear
rotate
worm gear

Building Notes

The worm gear in step 3 of the building instructions helps to make the stage turn slowly. The worm gear must turn 24 times for the stage to turn around once. Ask students to stop building at step 5 and turn the worm gear axle by hand to see this.

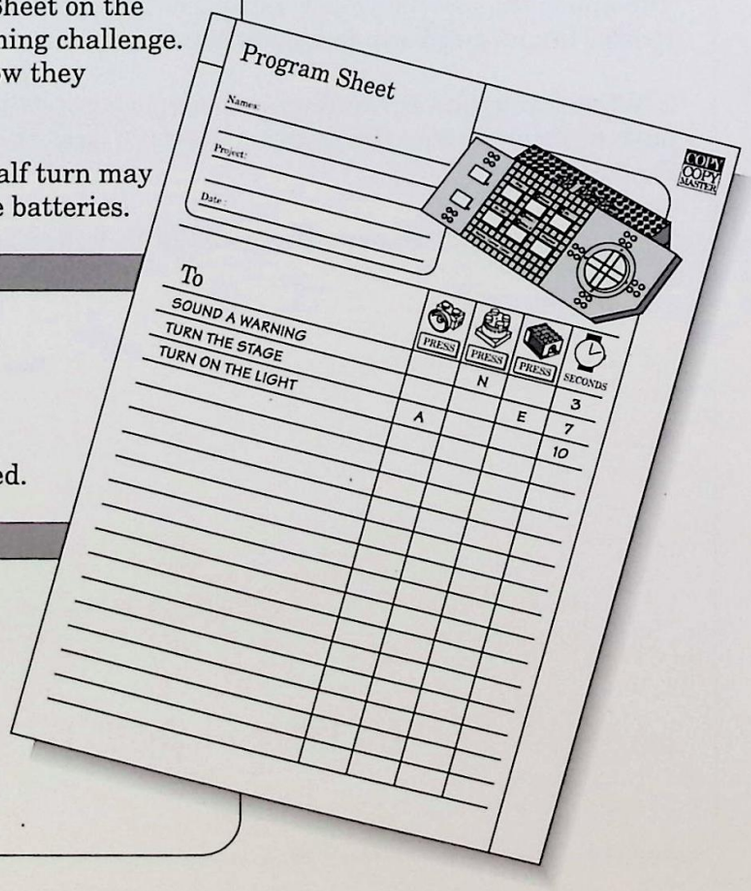
The pulley wheels, belts, and spur gears added in steps 5 and 6 also help make the stage turn slowly. A small pulley wheel or gear makes a larger pulley wheel or gear turn more slowly.

Encourage students to discuss why they connected the motor, lamp and sound element to the control center as they did.

Programming Notes

The sample program shown in the Program Sheet on the right is one possible solution to the programming challenge. Student solutions will differ, depending on how they connected their electrical elements.

The time it takes for the stage to rotate one-half turn may vary slightly, depending on the strength of the batteries.



Extension Ideas

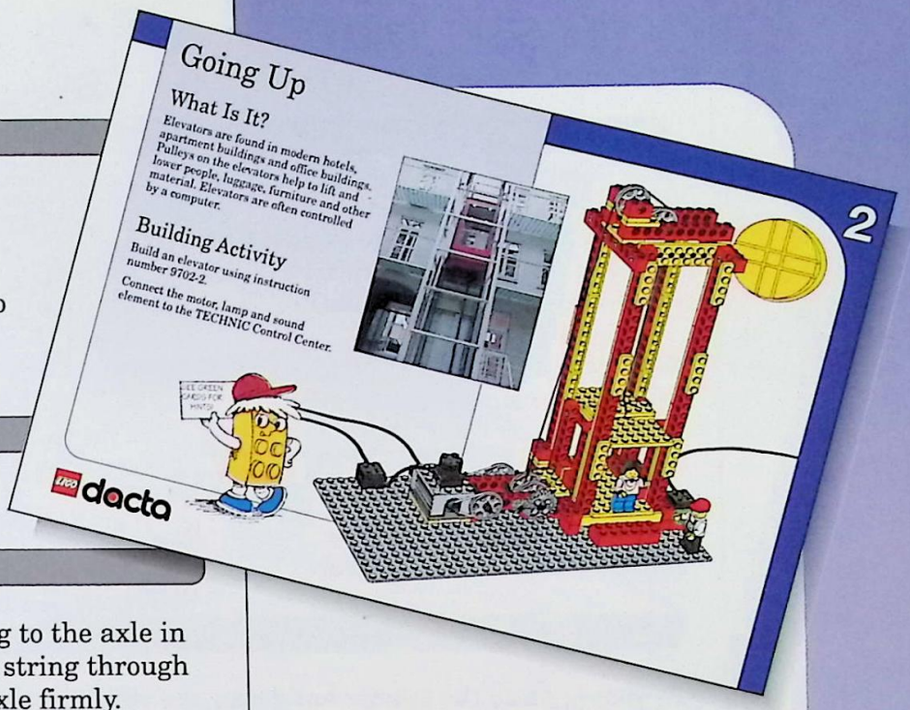
Decorate the stage with fabric backdrops and miniature furniture.

Ask students to find more information about different types of stages and how they are used.

Curriculum Areas

Physical science, communication, fine arts.

Going Up


Going Up
What Is It?
Elevators are found in modern hotels, apartment buildings and office buildings. Pulleys on the elevators help to lift and lower people, luggage, furniture and other material. Elevators are often controlled by a computer.
Building Activity
Build an elevator using instruction number 9702-2.
Connect the motor, lamp and sound element to the TECHNIC Control Center.
2
dacta

Objectives

Enable students to:

- Follow instructions to build a model of an elevator.
- Measure the time it takes the elevator to go up and down.
- Create a program to control the elevator.

Key Words

pulley wheel spur gear

Building Notes

You may have to help students affix the string to the axle in step 2 of the building instructions. Insert the string through the bushing and push the bushing onto the axle firmly.

In step 3, be sure to use the black connector pegs as shown and not the gray ones.

In steps 10 and 11, make sure the pulley wheels at the top of the elevator frame can rotate freely.

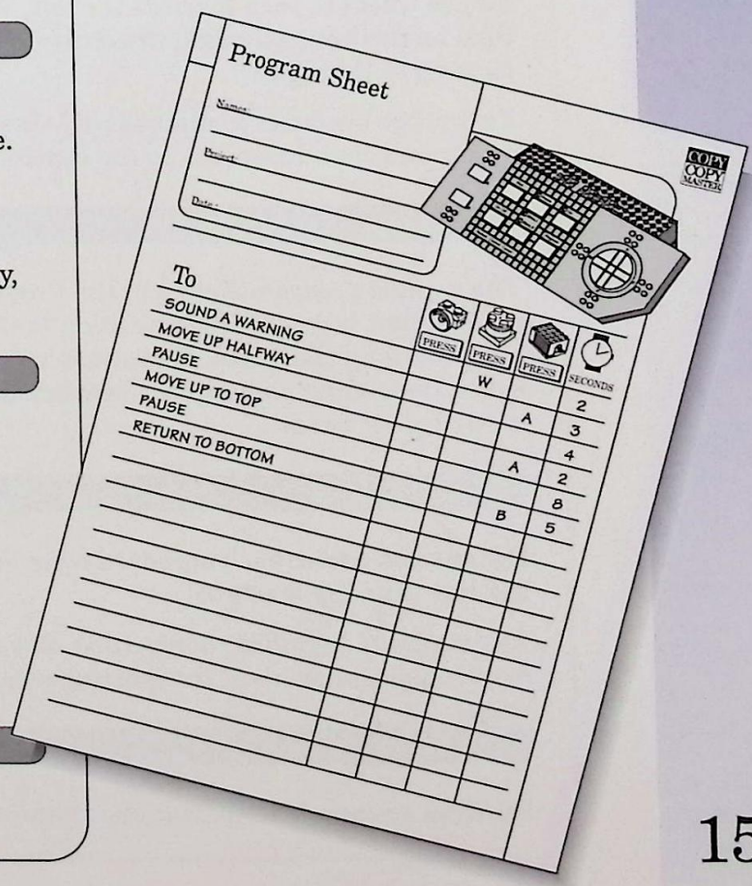
The pulley wheels, belts, and spur gears added in steps 4, 5 and 6 help make the elevator move slowly. A small pulley wheel or gear makes a larger pulley wheel or gear turn more slowly.

Encourage students to discuss why they connected the motor, lamp and sound element to the control center as they did.

Programming Notes

The sample program shown in the Program Sheet on the right is one possible solution to the programming challenge. Student solutions will differ, depending on how they connected their electrical elements.

The time it takes for the elevator to go up may vary slightly, depending on the strength of the batteries.



Extension Ideas

Enclose the elevator with cardboard, or place the elevator inside a cardboard building.

Ask students to research the history of the elevator. Archimedes developed an early hoisting device around 236 B.C. In 1852, Elisha Graves Otis invented an elevator safety device and a counterweight which made possible the development of the elevator industry.

Curriculum Areas

Physical science, transportation.

On the Line

Objectives

Enable students to:

- Follow instructions to build a model of a line drawing machine.
- Measure the time it takes to draw a line.
- Create a program to control the line drawing machine.

Key Words

bevel gear
subassembly
spur gear
worm gear

Building Notes

In step 6, place the rubber band over the red beam as shown. This will help to hold the pen in place.

The worm gear in step 8 helps to make the vehicle go slower.

In step 10, subassembly step 4, assemble the second red beam with axle, spur gear and bevel gear before placing it next to the first red beam.

Also in step 10, keep the cap on the TECHNIC pen until you are ready to draw a line.

The vehicle travels straight ahead when the motor turns in one direction. The vehicle turns continuously to the right when the direction of the motor is reversed. Students may be curious about this motion. Encourage them to investigate how it might work. (When the motor reverses, it is easiest for the wheel to turn towards the left. When the wheel can turn no further to the left, the entire vehicle begins turning to the right.)

Encourage students to discuss why they connected the motor and sound element to the control center as they did.

Programming Notes

The sample program shown in the Program Sheet on the right is one possible solution to the programming challenge. Student solutions will differ, depending on how they connected their electrical elements.

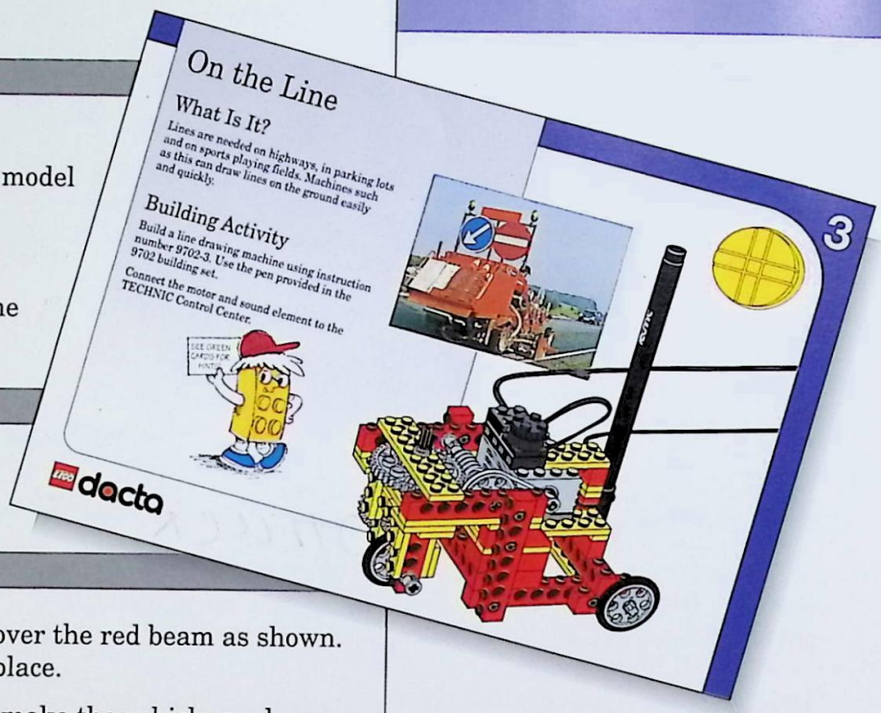
Extension Ideas

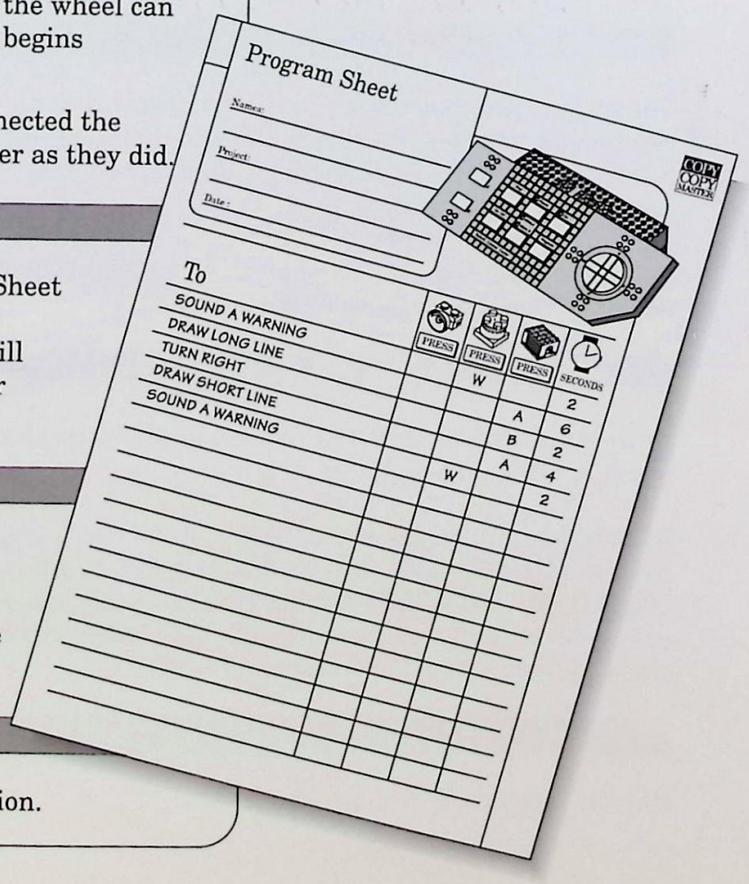
Design and decorate a cardboard body for the line drawing machine.

Ask students to collect information about line drawing machines used for sporting events.

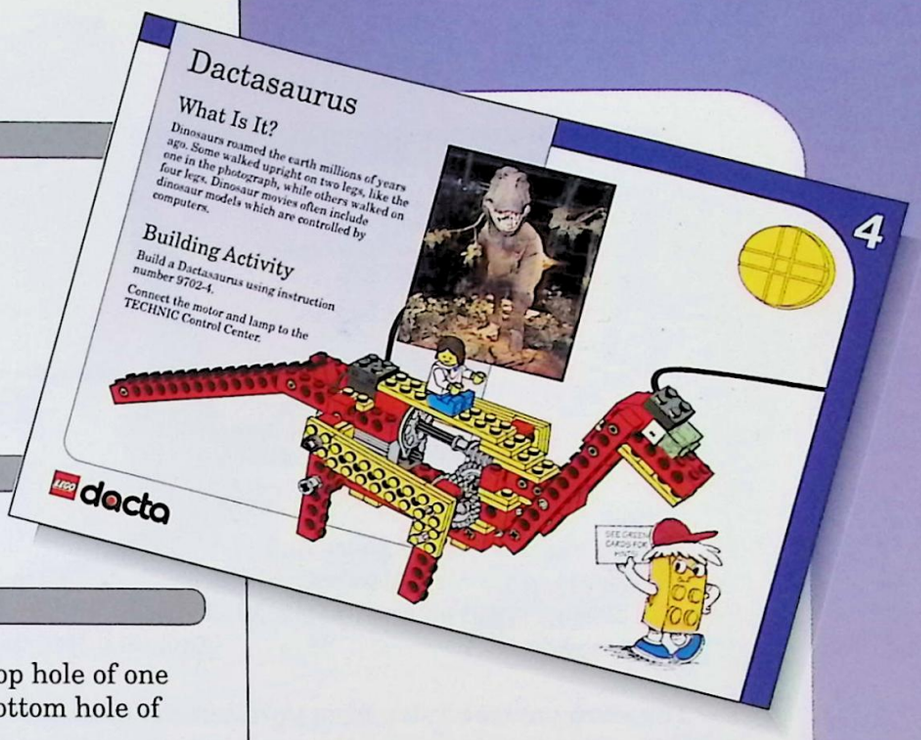
Curriculum Areas

Physical science, transportation, communication.


On the Line
What Is It?
Lines are needed on highways, in parking lots and on sports playing fields. Machines such as this can draw lines on the ground easily and quickly.
Building Activity
Build a line drawing machine using instruction number 9702-3. Use the pen provided in the 9702 building set.
Connect the motor and sound element to the TECHNIC Control Center.
3
dacta



Dactasaurus


Dactasaurus
What Is It?
Dinosaurs roamed the earth millions of years ago. Some walked upright on two legs, like the one in the photograph, while others walked on four legs. Dinosaur movies often include dinosaur models which are controlled by computers.
Building Activity
Build a Dactasaurus using instruction number 9702-4.
Connect the motor and lamp to the TECHNIC Control Center.
4
dacta

Objectives

Enable students to:

- Follow instructions to build a model of a walking dinosaur.
- Measure how many steps the dinosaur takes in one minute.
- Create a program to control the walking dinosaur.

Key Words

connector peg spur gear

Building Notes

In step 4, insert a gray connector peg in the top hole of one spur gear and another connector peg in the bottom hole of the other spur gear.

In step 5, the black connector pegs provide the right amount of friction for the dinosaur tail.

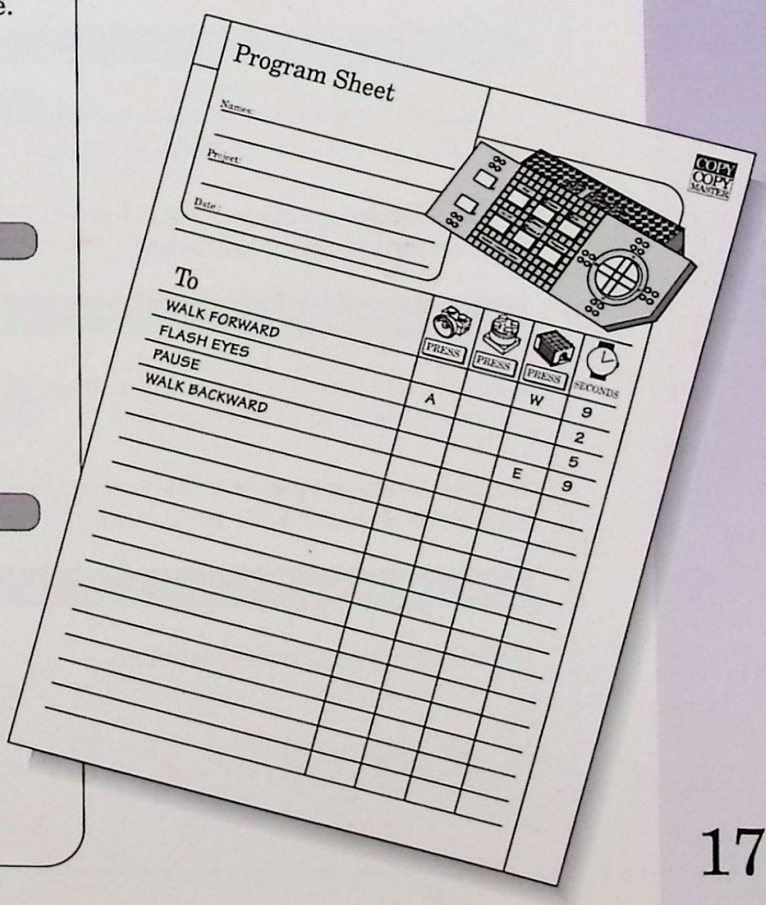
In step 6, the worm gear helps to make the dinosaur walk slowly.

Encourage students to discuss why they connected the motor and lamp to the control center as they did.

Programming Notes

The sample program shown in the Program Sheet on the right is one possible solution to the programming challenge. Student solutions will differ, depending on how they connected their electrical elements.

The speed with which the Dactasaurus walks may vary slightly, depending on the strength of the batteries.



Extension Ideas

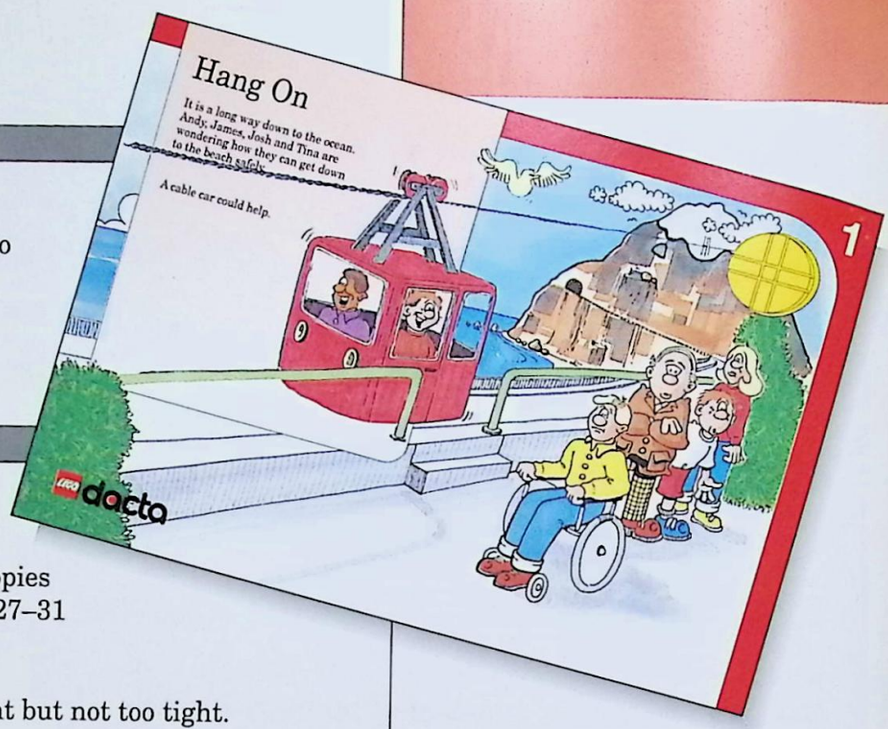
Surround the dinosaur model with a body created from fabric, cardboard or other materials.

Ask students to find more information about dinosaurs. Perhaps they can build models of different dinosaurs.

Curriculum Areas

Physical science, social studies, robotics.

Hang On


Hang On
It is a long way down to the ocean. Andy, James, Josh and Tina are wondering how they can get down to the beach safely.
A cable car could help.
1
LEGO dacta

Objectives

Enable students to:

- Design and build a cable car to solve a problem.
- Create a program to control the cable car.
- Evaluate the solution.

Building Notes

If your students need help in getting started on designing and building a cable car, distribute copies of drawings selected from pages 27–31 of this guide.

The string must be stretched tight but not too tight. Experiment with string held up at a steep angle.

Encourage students to try different designs if time permits.

Programming Notes

The sample program shown in the Program Sheet on the right is one possible solution to the programming challenge. Student solutions will differ, depending on how they connected their electrical elements.

It is easy to flash the light and move the cable car at the same time if students connect the lamp and the motor to the red and blue connectors on the TECHNIC Control Center.

Evaluation Notes

Measure the time it takes for a cable car to travel along 12 inches (30.5 centimeters) of string.

Determine how many LEGO® figures can fit comfortably into the cable car.

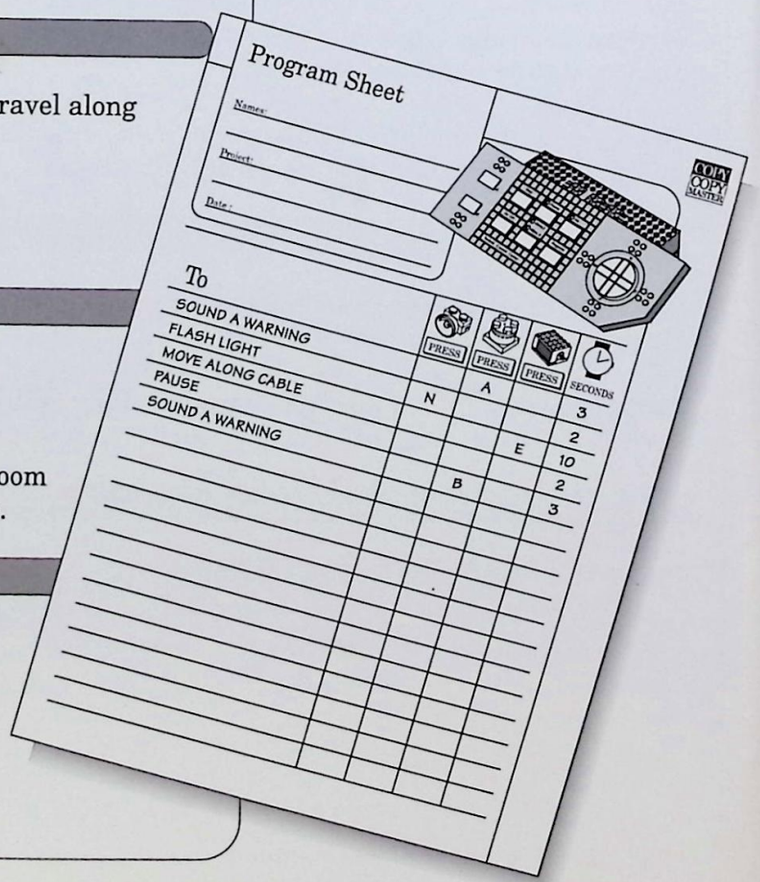
Extension Ideas

Encourage students to describe other places where cable cars might be used.

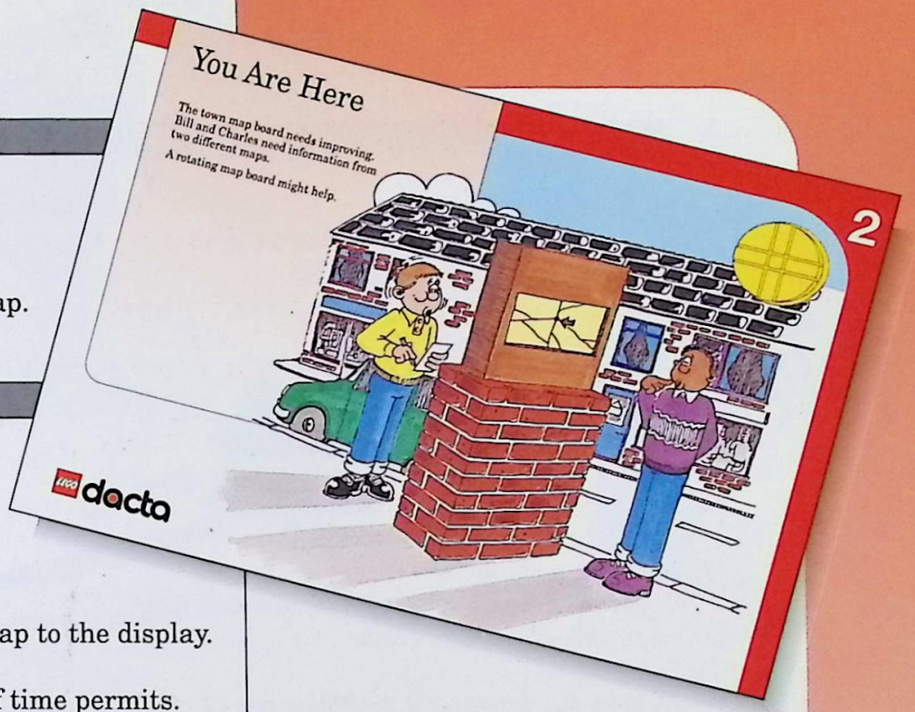
Suspend two or more cables across the classroom and have several cable cars in motion at once.

Curriculum Areas

Physical science, transportation.



You Are Here


You Are Here
The town map board needs improving. Bill and Charles need information from two different maps.
A rotating map board might help.
2
dacta

Objectives

Enable students to:

- Design and build a turning map to solve a problem.
- Create a program to control the turning map.
- Evaluate the solution.

Building Notes

If your students need help in getting started on designing and building a motorized map board, distribute copies of drawings selected from pages 32–34 of this guide.

Note the use of tape in step 5 to secure the map to the display.

Encourage students to try different designs if time permits.

Programming Notes

The sample program shown in the Program Sheet on the right is one possible solution to the programming challenge. Student solutions will differ, depending on how they connected their electrical elements.

Encourage students to discuss the importance of pausing in the program.

Evaluation Notes

Measure the time for the map to complete one full turn.

Tape maps to all available rotating surfaces.

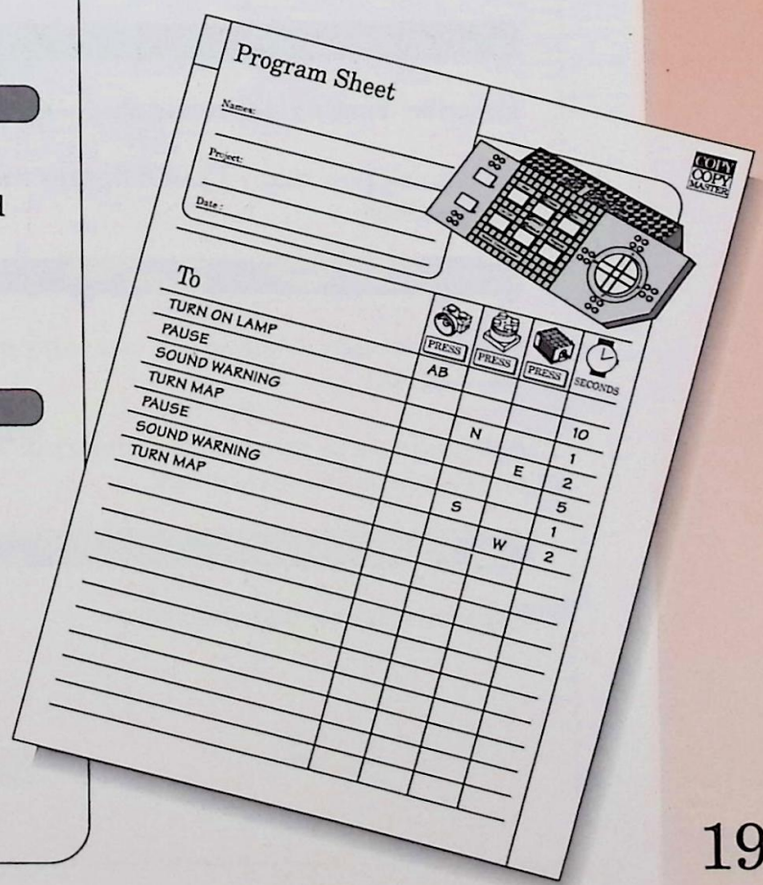
Extension Ideas

Discuss with students other applications of this type of display, including how to provide information for blind and disabled people.

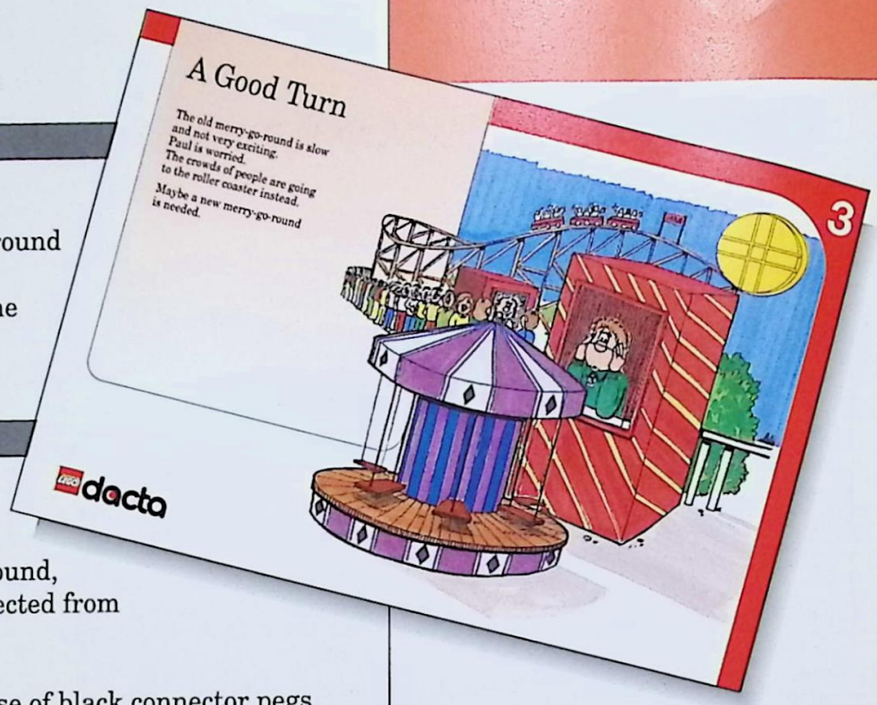
Suggest that students group their displays together to create a message delivered in a sequence.

Curriculum Areas

Physical science, communication.



A Good Turn


A Good Turn
The old merry-go-round is slow and not very exciting.
Paul is worried.
The crowds of people are going to the roller coaster instead.
Maybe a new merry-go-round is needed.
3
dacta

Objectives

Enable students to:

- Design and build a merry-go-round to solve a problem.
- Create a program to control the merry-go-round.
- Evaluate the solution.

Building Notes

If your students need help in getting started on designing and building a motorized merry-go-round, distribute copies of drawings selected from pages 35–37 of this guide.

In step 4a, drawing 1, note the use of black connector pegs at the far ends of the beams, and gray connector pegs near the center.

Encourage students to try different designs if time permits.

Programming Notes

The sample program shown in the Program Sheet on the right is one possible solution to the programming challenge. Student solutions will differ, depending on how they connected their electrical elements.

Discuss with students the importance of pausing before turning in reverse, to minimize whiplash in the riders.

Evaluation Notes

Describe what a rider would see, hear and feel.

Determine how many LEGO® figures the ride can carry safely.

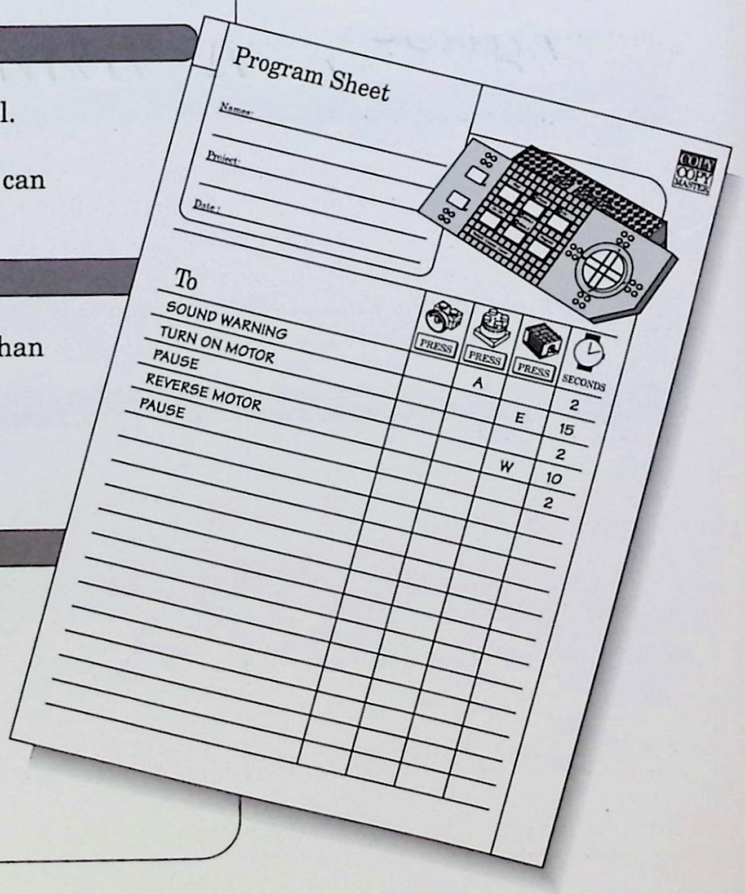
Extension Ideas

Can you design a ride which can carry more than two figures?

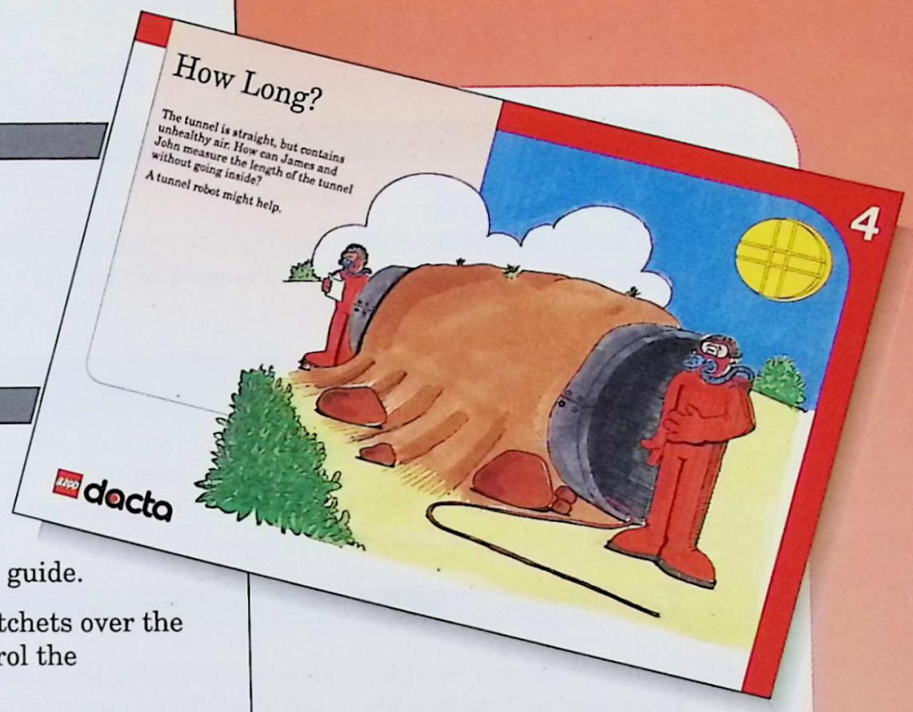
Ask students to research the history of the merry-go-round (or carousel).

Curriculum Areas

Physical science, transportation.



How Long?


How Long?
The tunnel is straight, but contains unhealthy air. How can James and John measure the length of the tunnel without going inside?
A tunnel robot might help.
4
dacta

Objectives

Enable students to:

- Design and build a measuring machine to solve a problem.
- Create a program to control the machine.
- Evaluate the solution.

Building Notes

If your students need help in getting started on designing and building a motorized vehicle to measure distance, distribute copies of drawings selected from pages 38–40 of this guide.

Students will have to experiment with the ratchets over the wheel gears to learn how their positions control the movement of the vehicle.

Because of the friction of the wheels, the vehicle may operate differently on different surfaces.

Encourage students to try different designs if time permits.

Programming Notes

The vehicle should "beep" with each "step" it takes.

The sample program shown in the Program Sheet on the right is one possible solution to the programming challenge. Student solutions will differ, depending on how they connected their electrical elements.

For continuous operation, students can press the Go button twice quickly.

Evaluation Notes

Measure how far the vehicle travels in one "step and beep" cycle. Multiply this distance by how many times the sound element "beeps" to obtain the total travel distance.

Measure how much time the vehicle takes to travel 12 inches (30.5 centimeters).

Discuss with students how robots can be used in areas hazardous to humans.

Extension Ideas

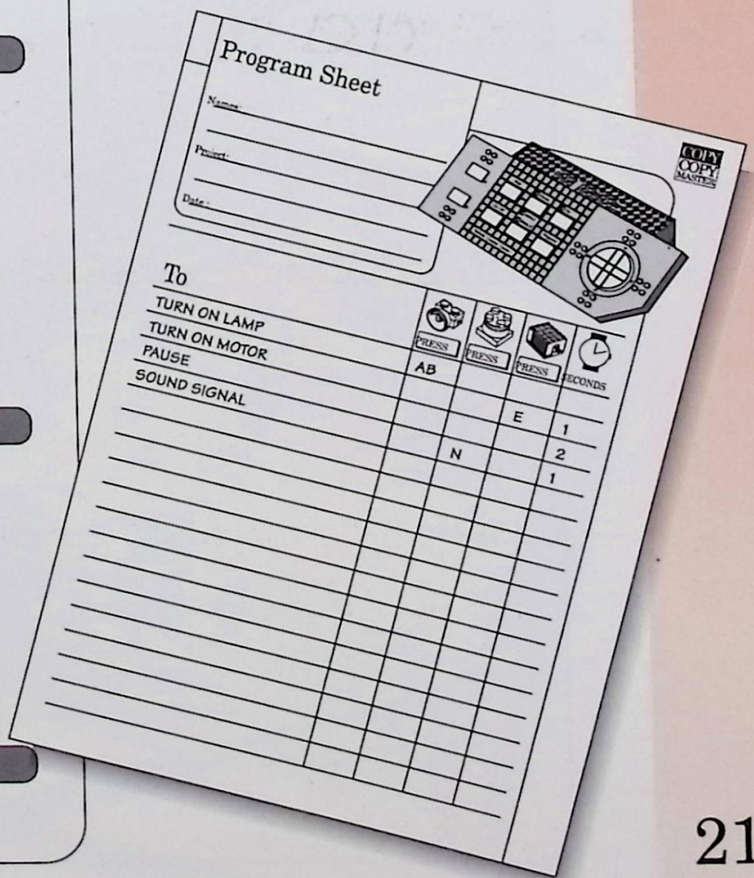
Create a "skin" for the vehicle from cardboard or construction paper.

Build a long tunnel out of cardboard and newspapers and use the vehicle to measure its length.

Ask students to find more information about remote controlled robots.

Curriculum Areas

Physical science, robotics, transportation, health.



Lights Out

Objectives

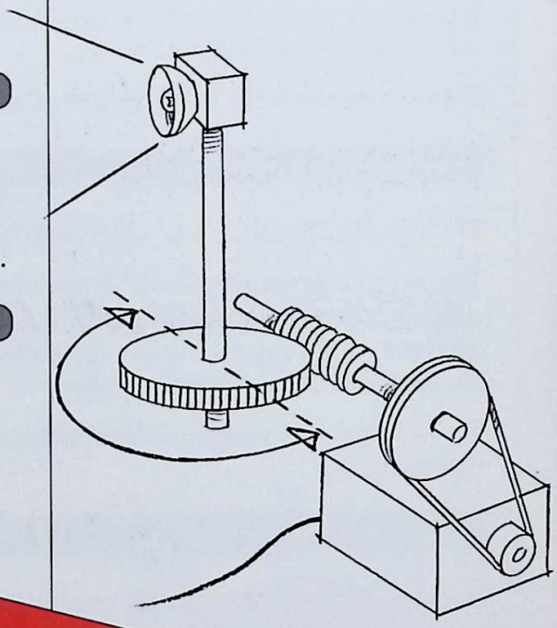
Enable students to:
- Design and build a warning light to solve a problem.
- Create a program to control the warning light.
- Evaluate the solution.

Building Notes

Lighthouses are not the only solution, but they are fun and easy to build.
Encourage students to think about other lighting solutions, such as vehicles, boats, and the like.

Evaluation Notes

Students should be able to see their warning lights from far away, and should be able to tell the difference between long and short flashes.

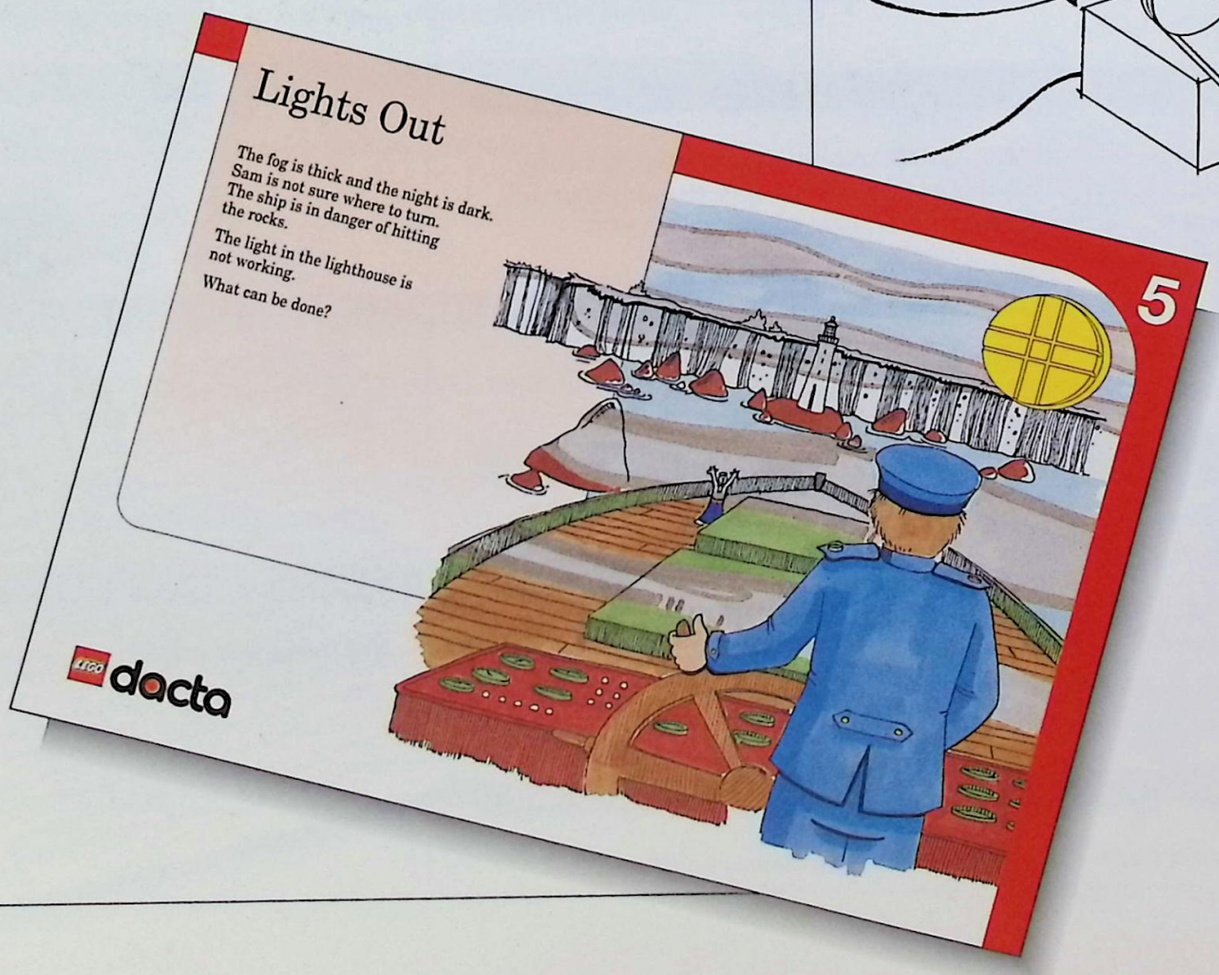


Extension Ideas

Challenge students to program a message in Morse code with their light system.
Add a motor to swing the lamp back and forth.
Ask students to find out more information about lighthouses.

Curriculum Areas

Physical science, communication, transportation.


Lights Out
The fog is thick and the night is dark.
Sam is not sure where to turn.
The ship is in danger of hitting the rocks.
The light in the lighthouse is not working.
What can be done?
5
LEGO dacta

Boring

Objectives

Enable students to:

- Design and build an exciting device or ride to solve a problem.
- Create a program to control the device or ride.
- Evaluate the solution.

Building Notes

Rotary rides such as carousels and ferris wheels are popular. Entertainment devices such as a moving disco stage might be fun.

Evaluation Notes

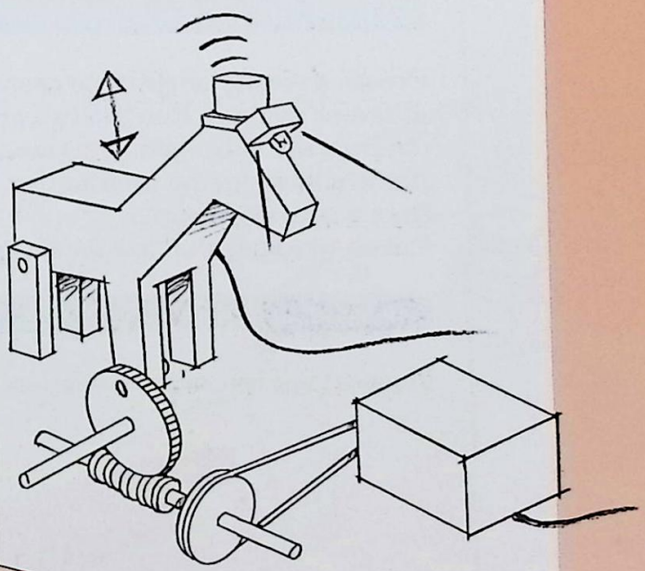
Determine how many LEGO® figures can be entertained at one time.
Describe what sensations people would feel.

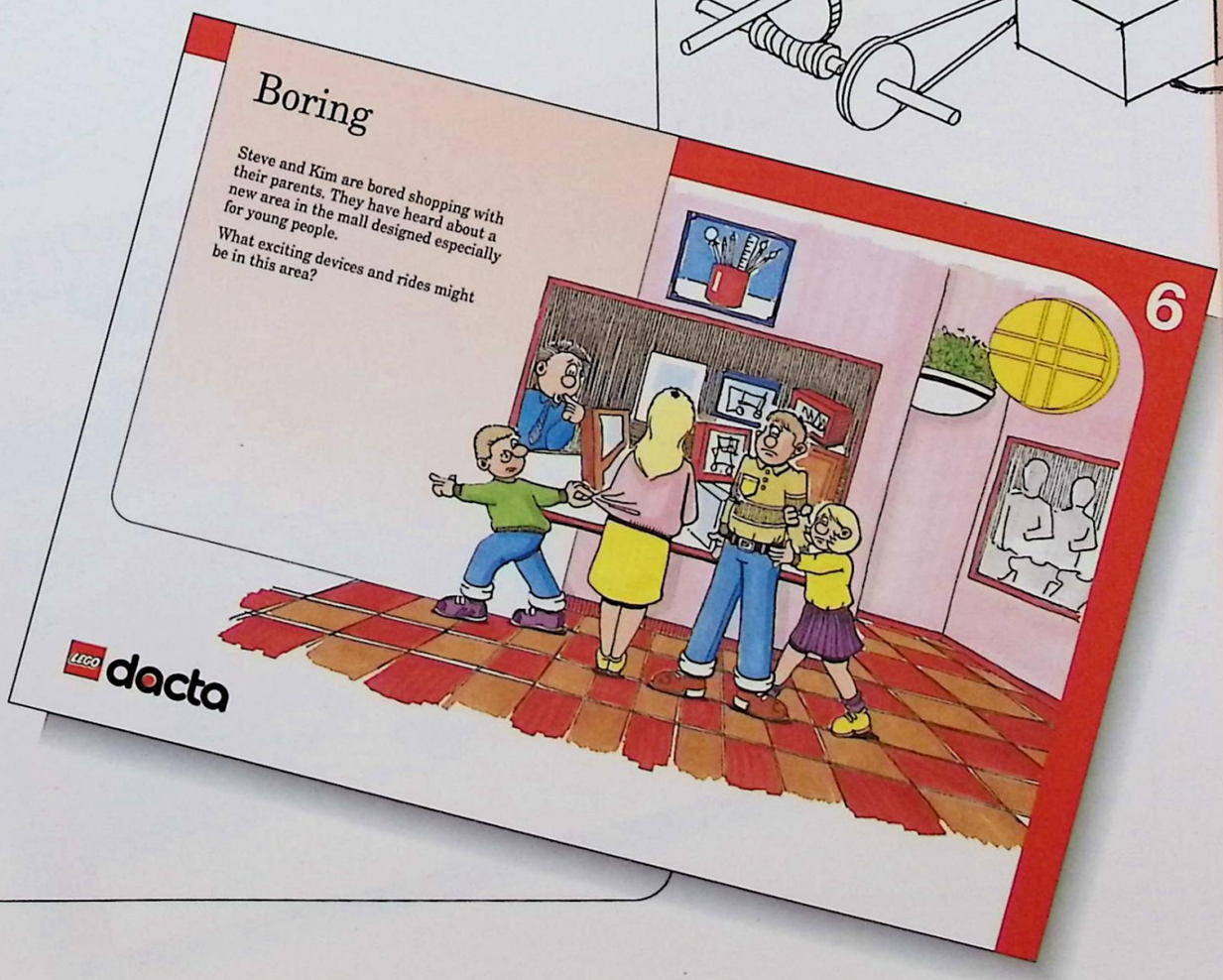
Extension Ideas

Decorate your device or ride with colorful paper, pipe cleaners, cardboard or other similar material.
Ask students to find information about amusement parks and the various rides they feature.

Curriculum Areas

Physical science.




Boring
Steve and Kim are bored shopping with their parents. They have heard about a new area in the mall designed especially for young people.
What exciting devices and rides might be in this area?
6
LEGO dacta

Landing Pad

Objectives

Enable students to:
- Design and build a helicopter signal to solve a problem.
- Create a program to control the signal.
- Evaluate the solution.

Building Notes

A helicopter needs a flat area for landing that is also well lighted.
A wind indicator (wind sock or flag) is always helpful.

Evaluation Notes

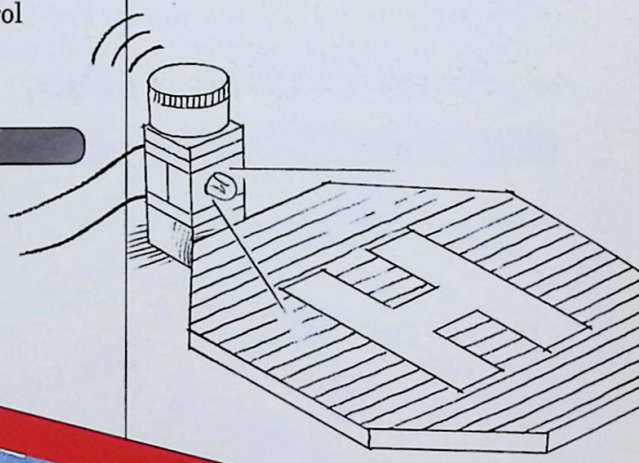
The lights should be easily visible from above and from far away as well.

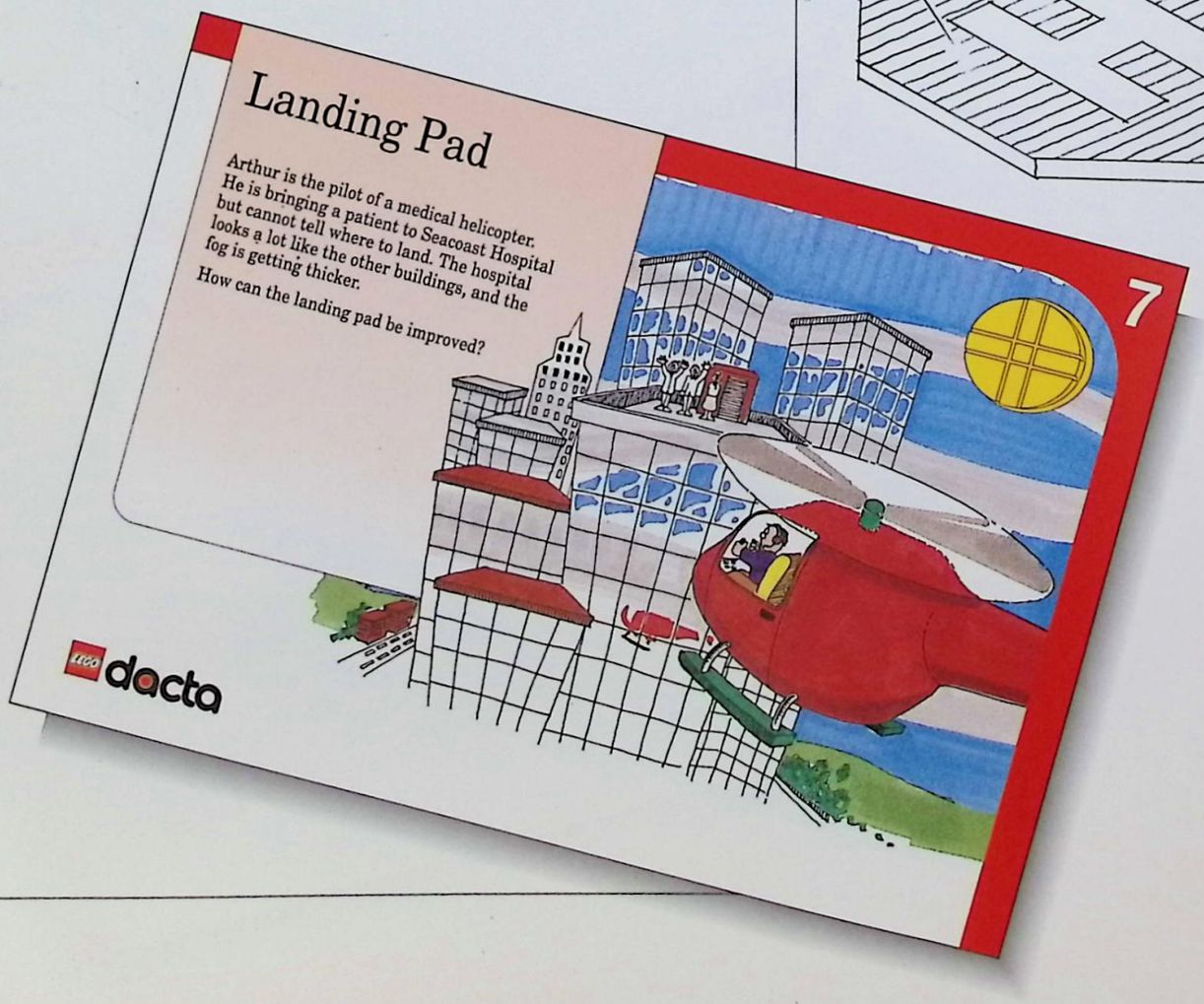
Extension Ideas

Create a second program to operate your signal in a different manner. Run the two programs one after the other as the helicopter gets closer to the pad.
Ask students to find information about air traffic control from a nearby airport.
Does a local hospital use a helicopter service?

Curriculum Areas

Physical science, communication.




Landing Pad
Arthur is the pilot of a medical helicopter. He is bringing a patient to Seacoast Hospital but cannot tell where to land. The hospital looks a lot like the other buildings, and the fog is getting thicker.
How can the landing pad be improved?
7
dacta

On Target

Objectives

Enable students to:

- Design and build a device with moving targets to solve a problem.
- Create a program to control the device.
- Evaluate the solution.

Building Notes

Rotating targets are often difficult to hit, but they should not rotate too fast.

Evaluation Notes

Attempt to hit the targets with small paper wads.

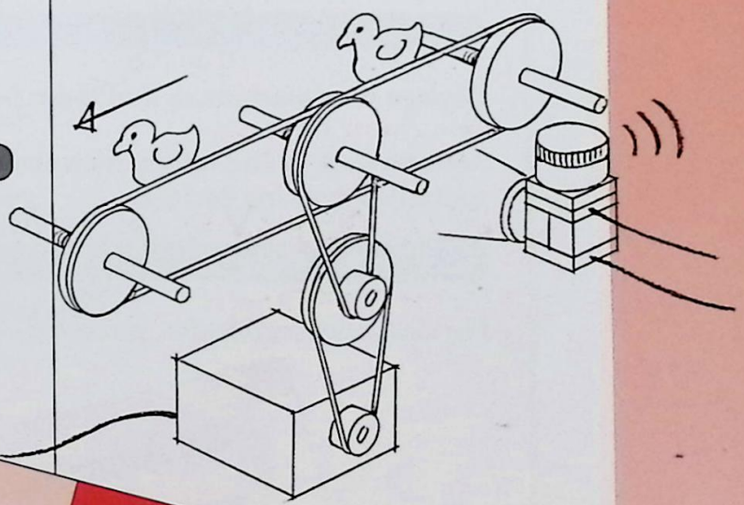
Extension Ideas

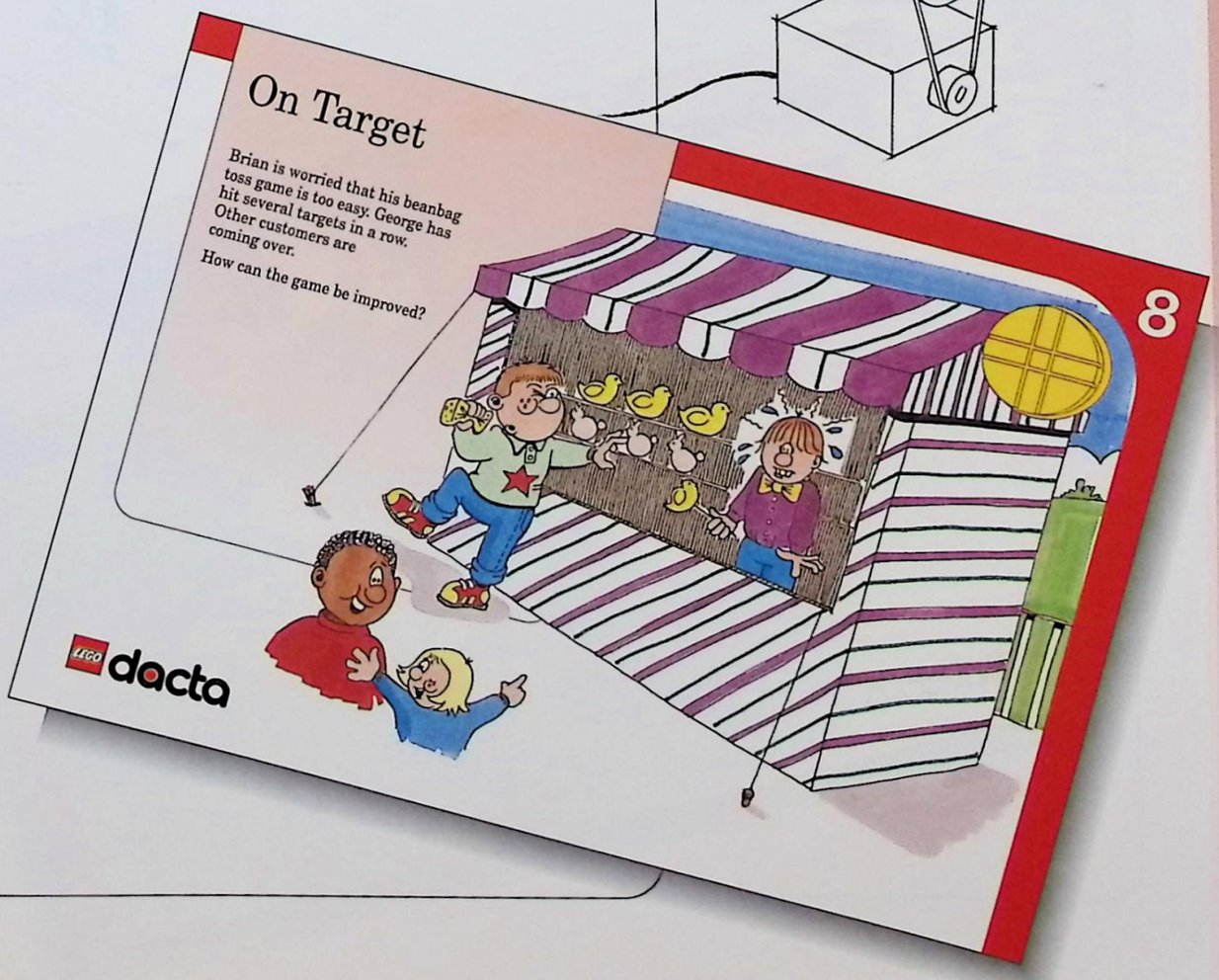
Build and decorate a cardboard house for your motorized beanbag game.

Ask students to find more information about carnivals and sideshows.

Curriculum Areas

Physical science.




On Target
Brian is worried that his beanbag toss game is too easy. George has hit several targets in a row. Other customers are coming over.
How can the game be improved?
8
LEGO dacta

An Amazing Task

Objectives

Enable students to:

- Design and build a motorized line drawing machine to solve a problem.
- Create a program to control the machine.
- Evaluate the solution.

Building Notes

The vehicle in building instruction 9702-3 might be a good starting point.

Evaluation Notes

Measure the longest straight portion of a line the machine draws.

With a protractor, measure the angle of the turn of the machine.

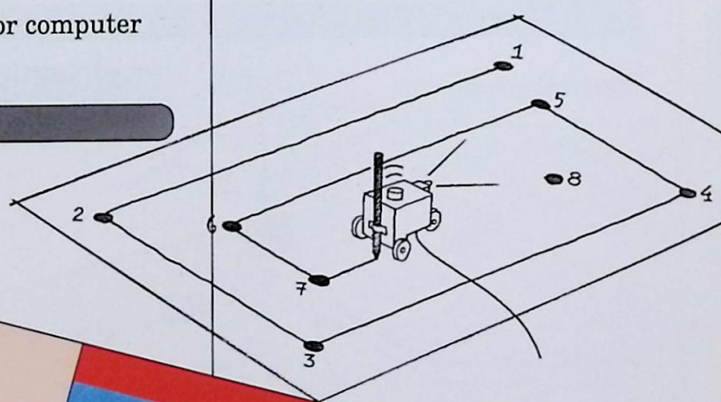
Extension Ideas

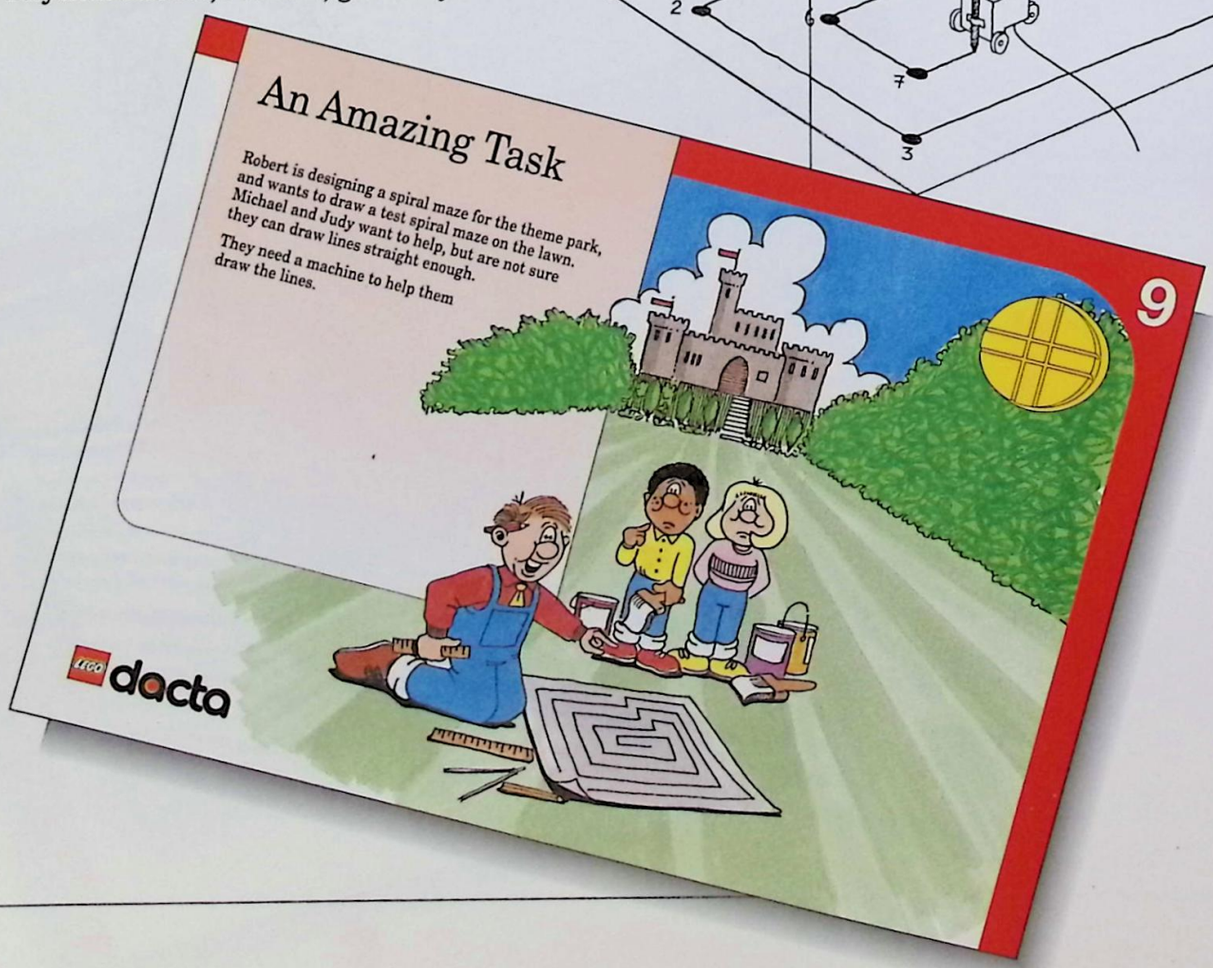
Change your machine so that it can be operated at night.

Ask students to find information about robotic or computer controlled drawing devices.

Curriculum Areas

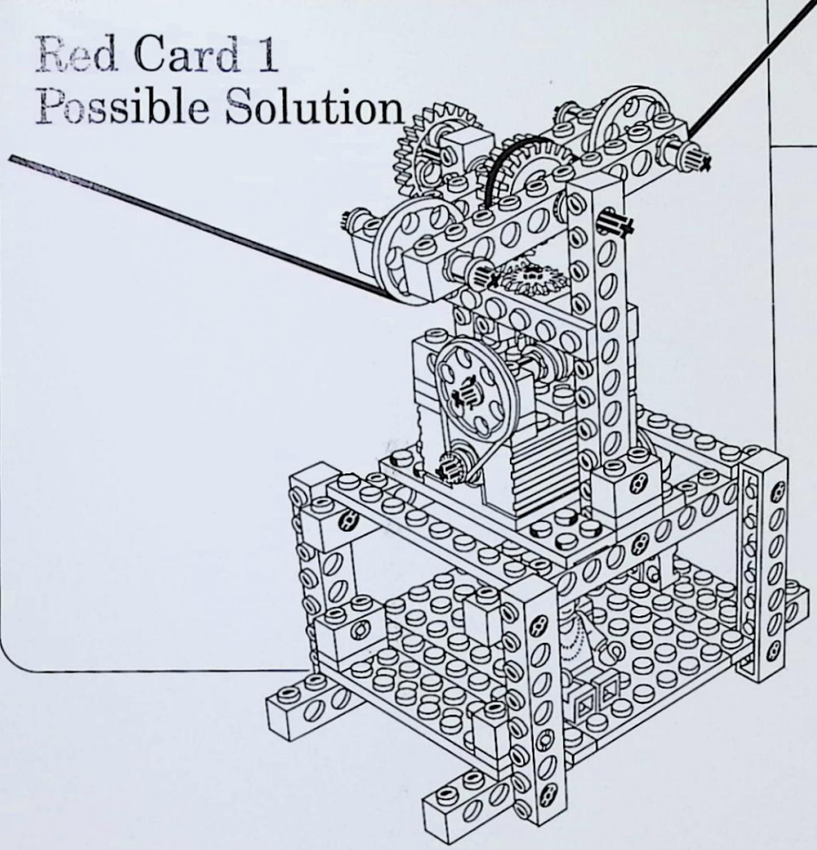
Physical science, robotics, geometry.

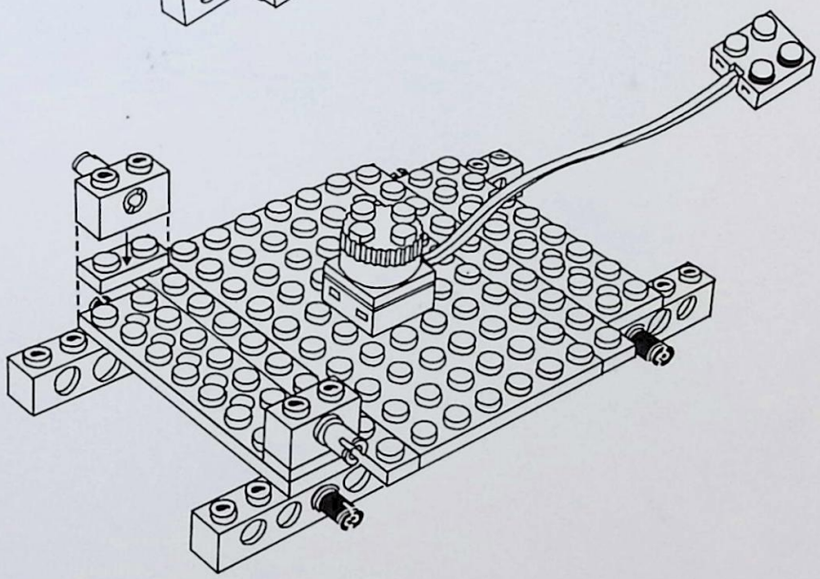



An Amazing Task
Robert is designing a spiral maze for the theme park, and wants to draw a test spiral maze on the lawn. Michael and Judy want to help, but are not sure they can draw lines straight enough.
They need a machine to help them draw the lines.
9
dacta

Red Card 1
Possible Solution

COPY
COPY
MASTER





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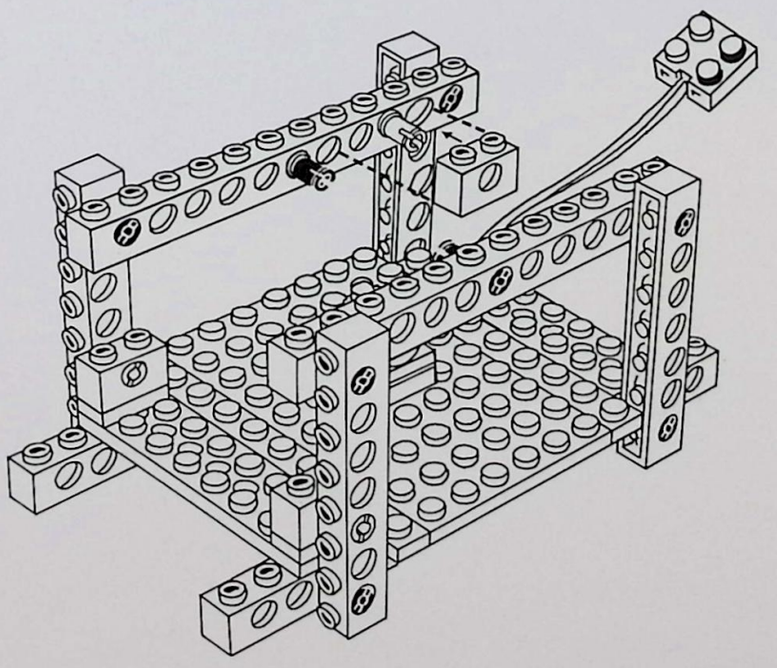

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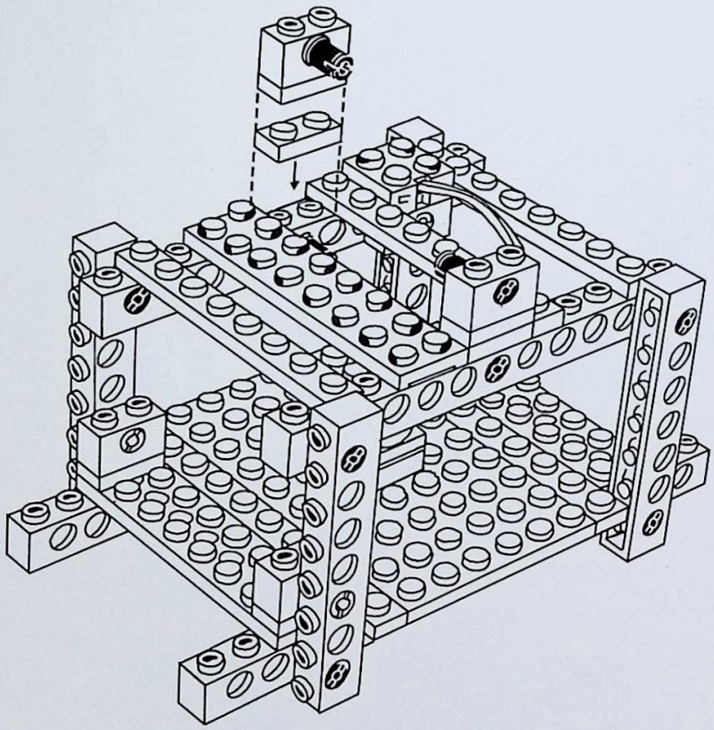
Red Card 1
Possible Solution

❸



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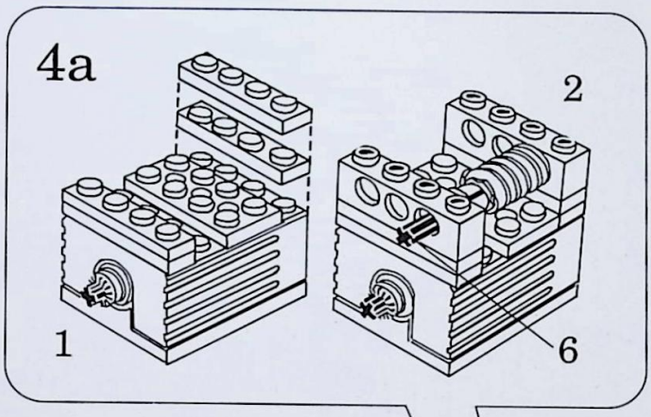

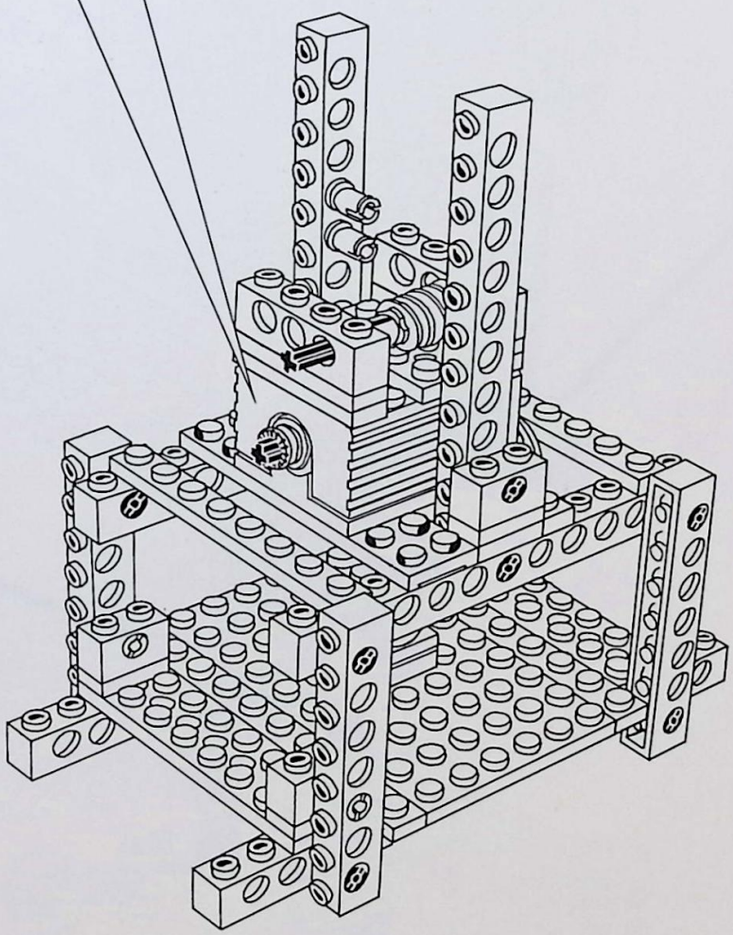

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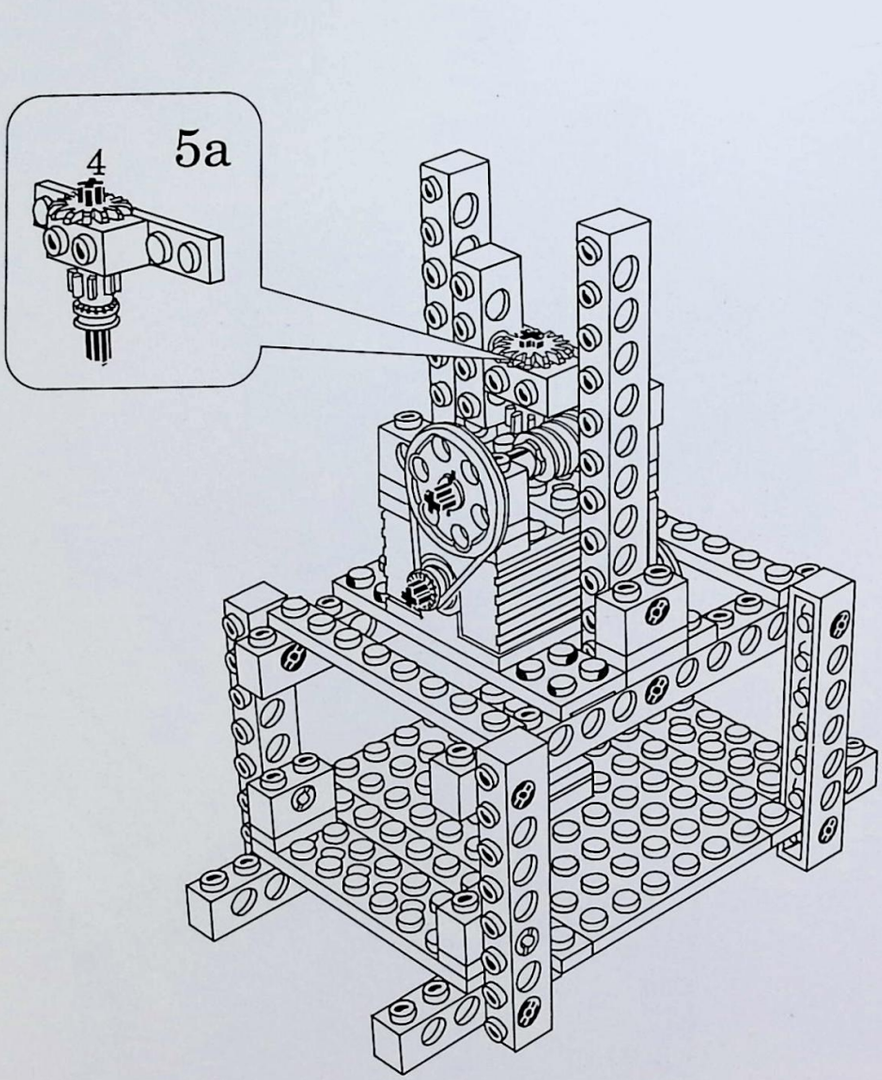
Red Card 1
Possible Solution



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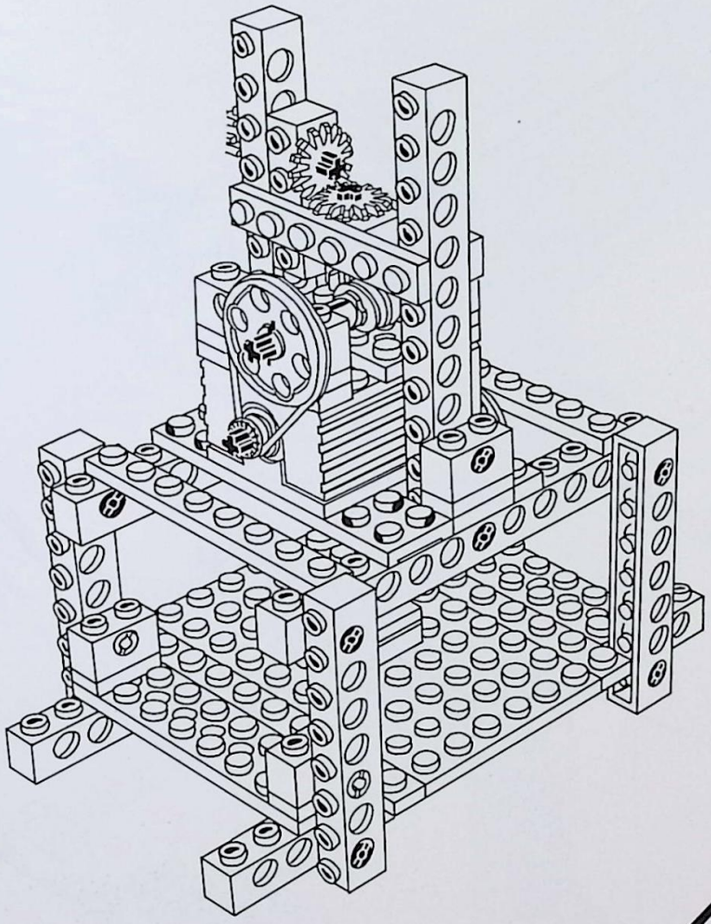

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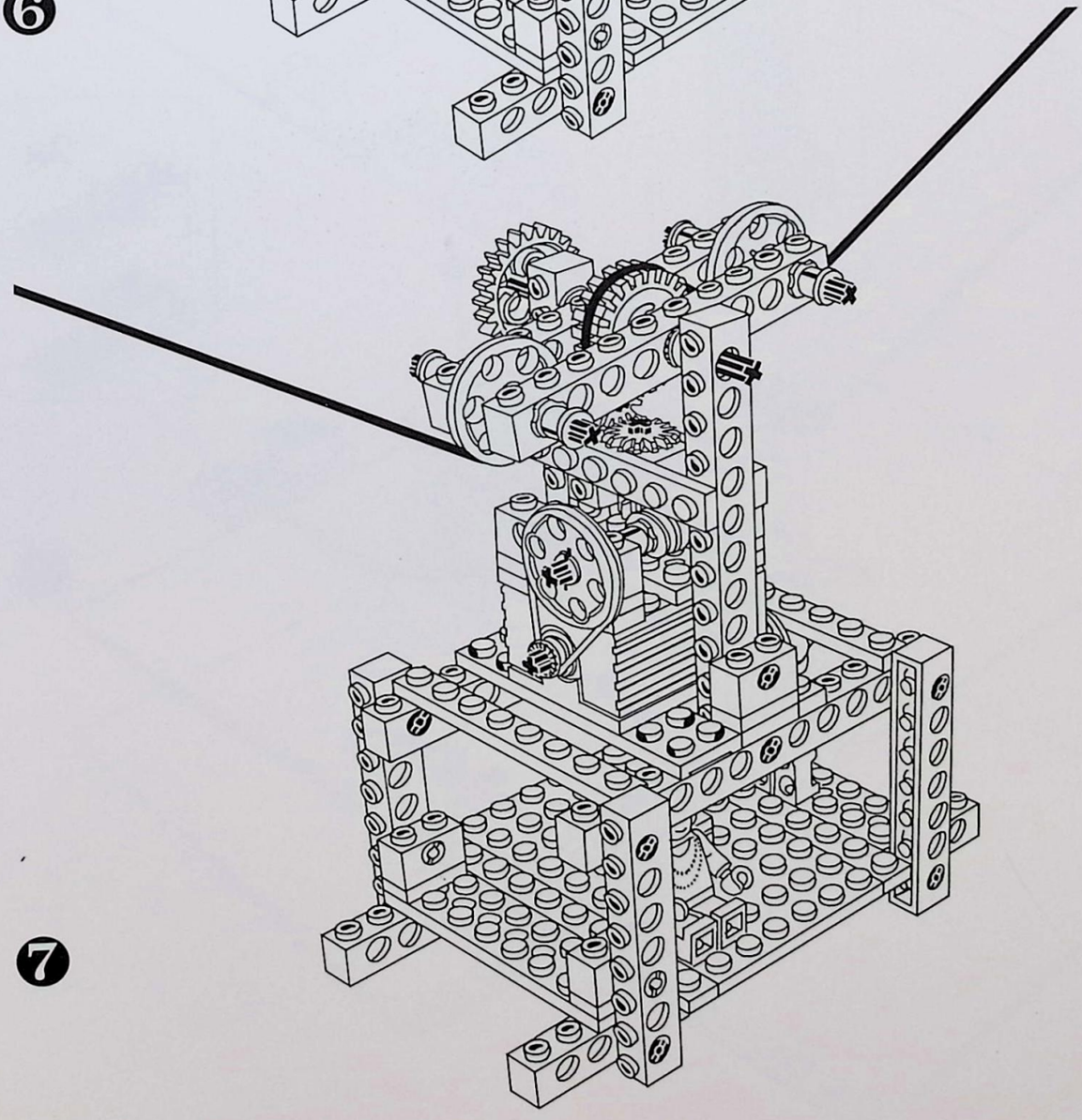

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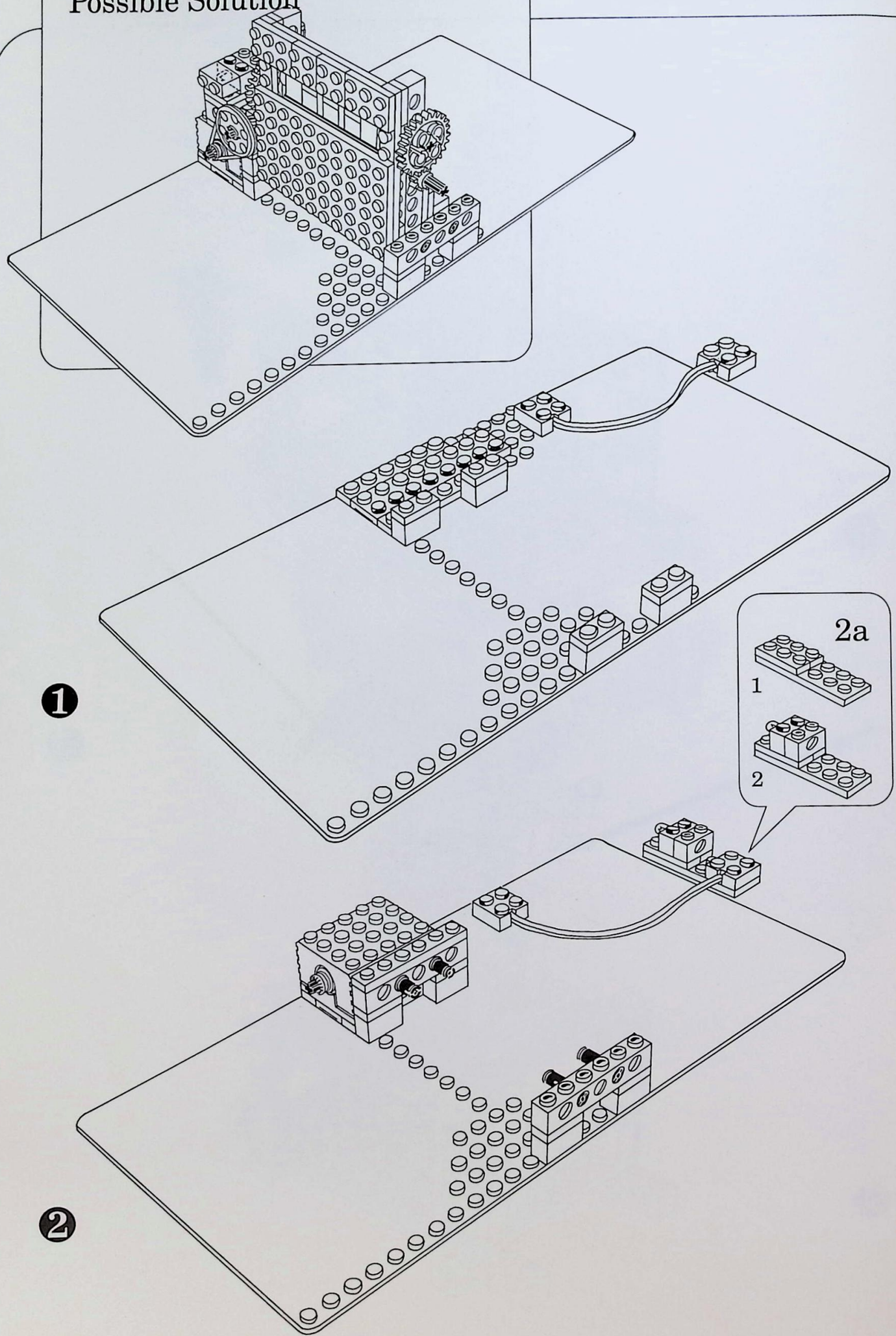
Red Card 2
Possible Solution



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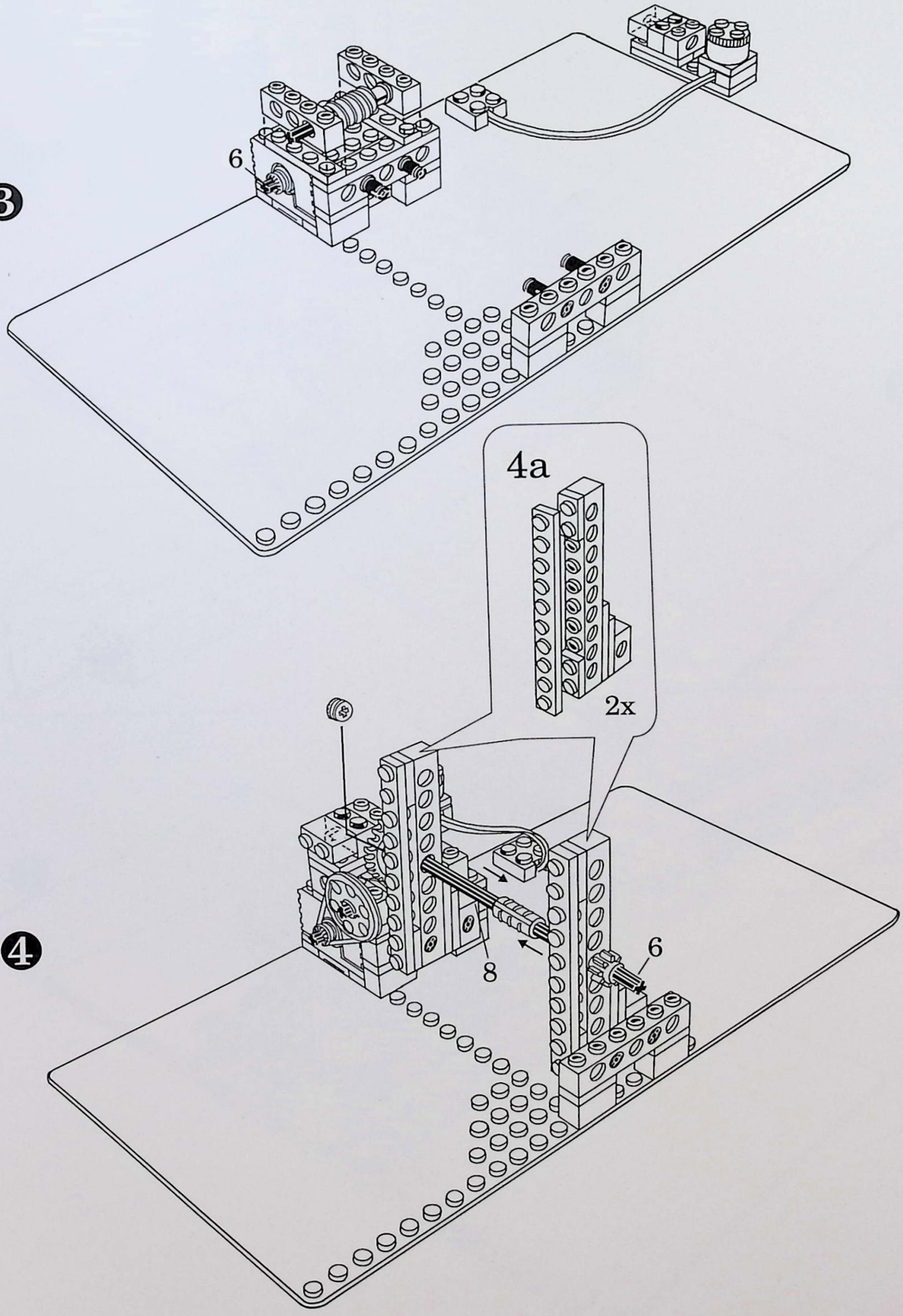

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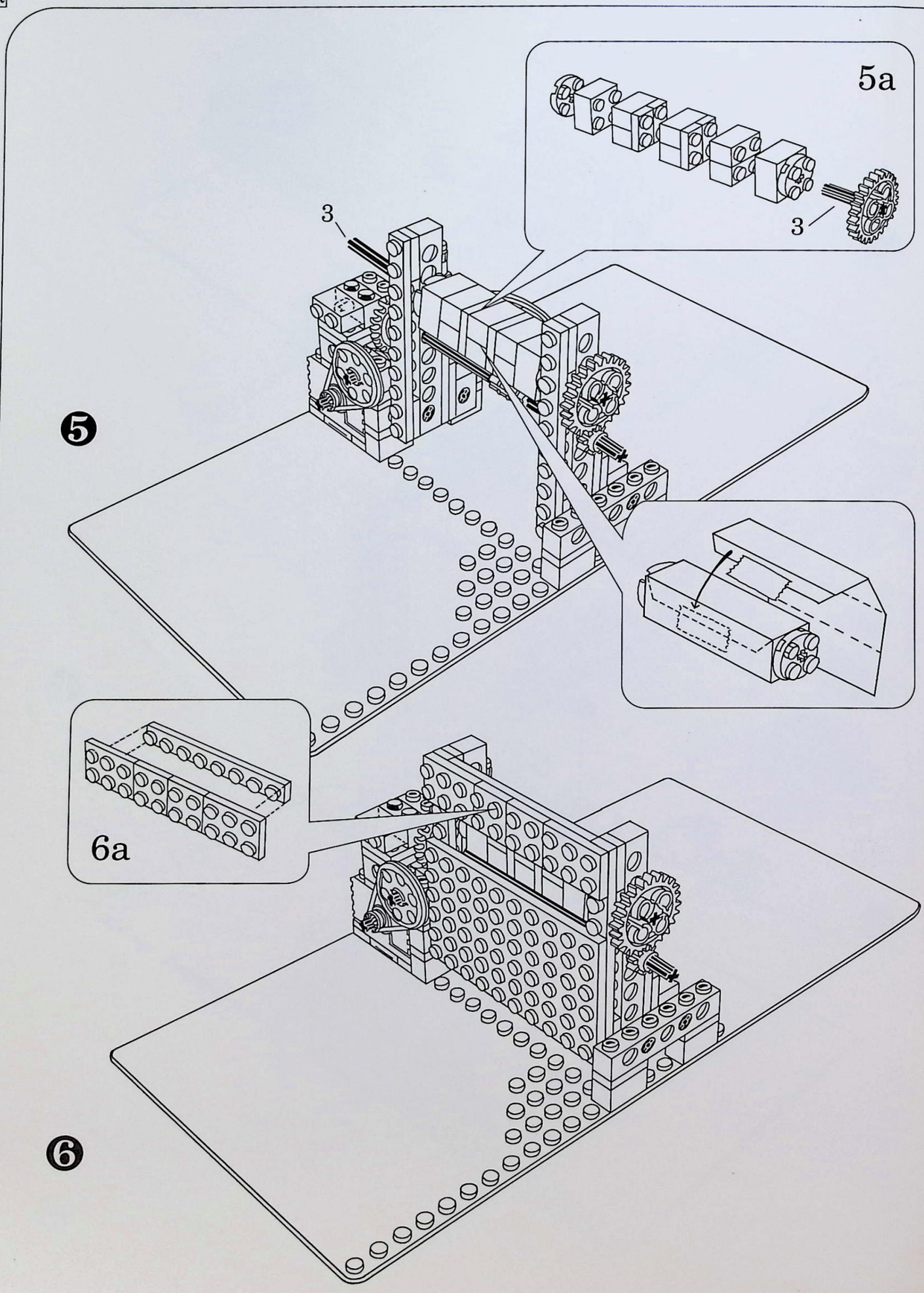
Red Card 2
Possible Solution



Red Card 3
Possible Solution

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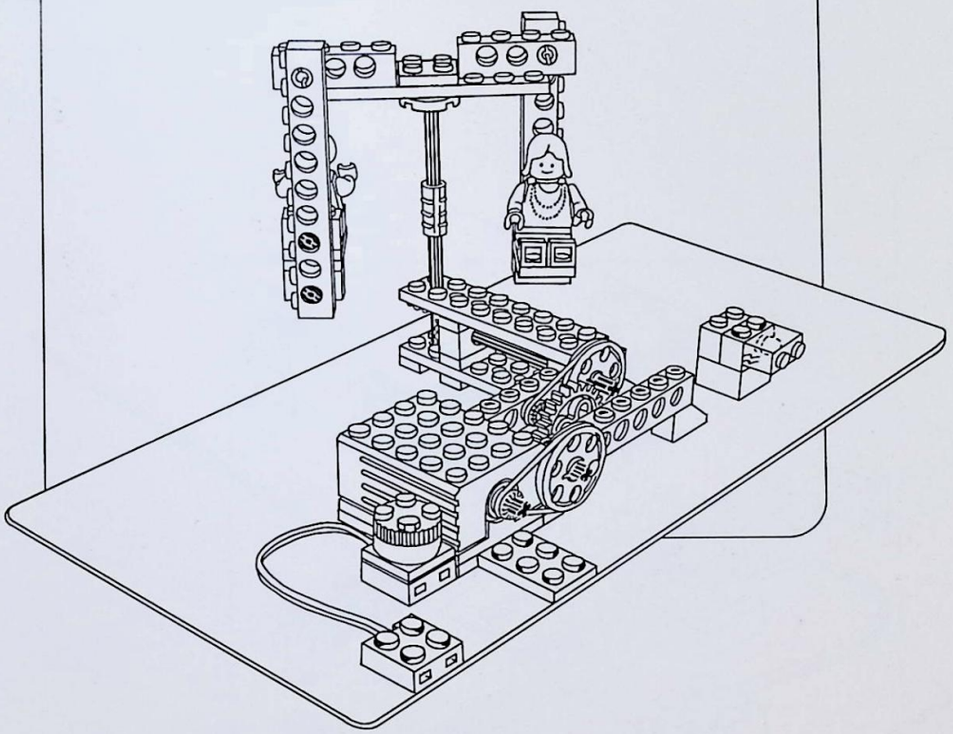

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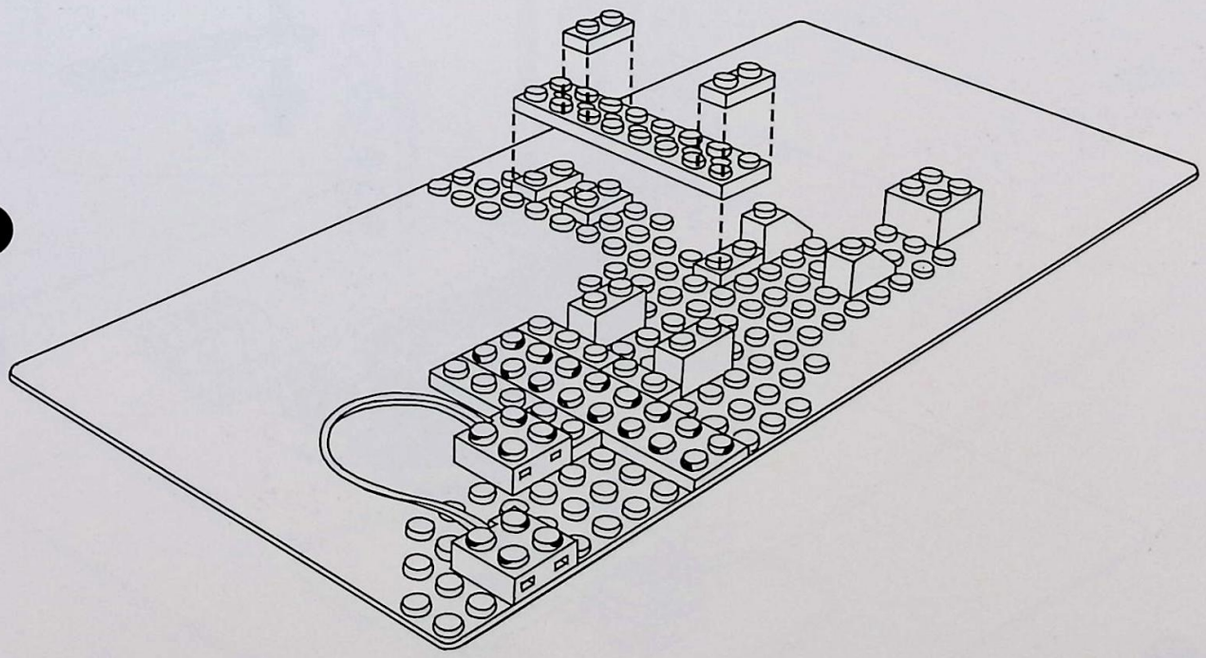

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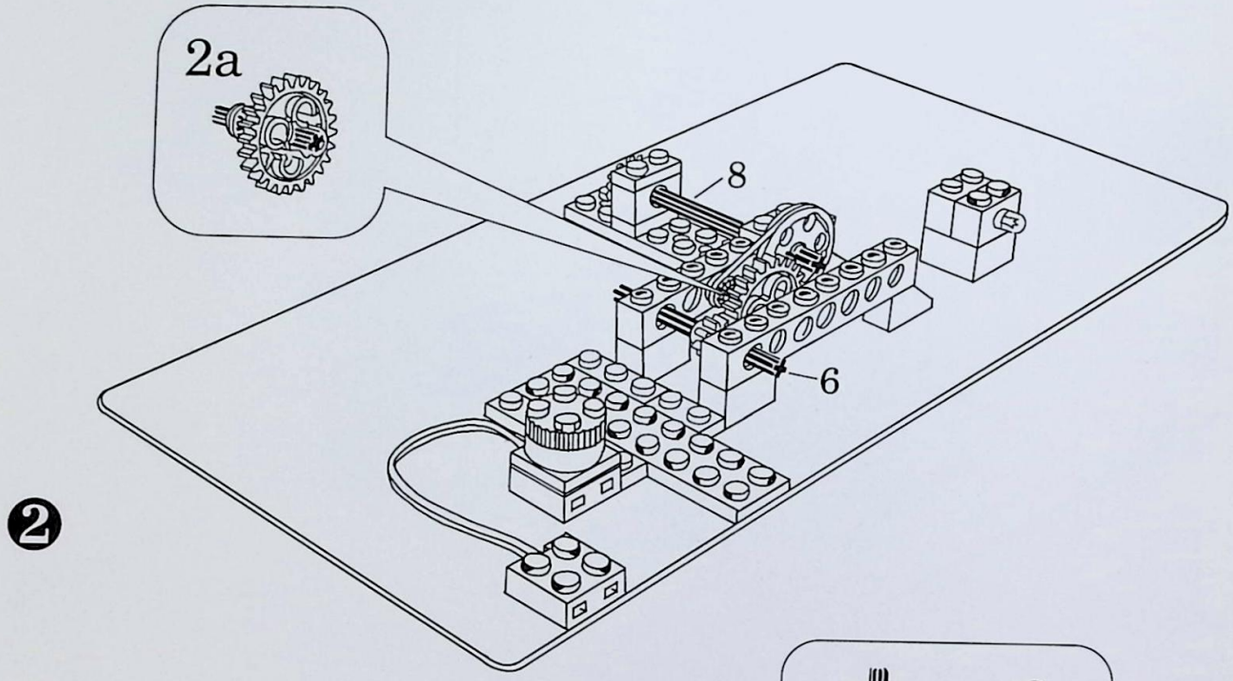

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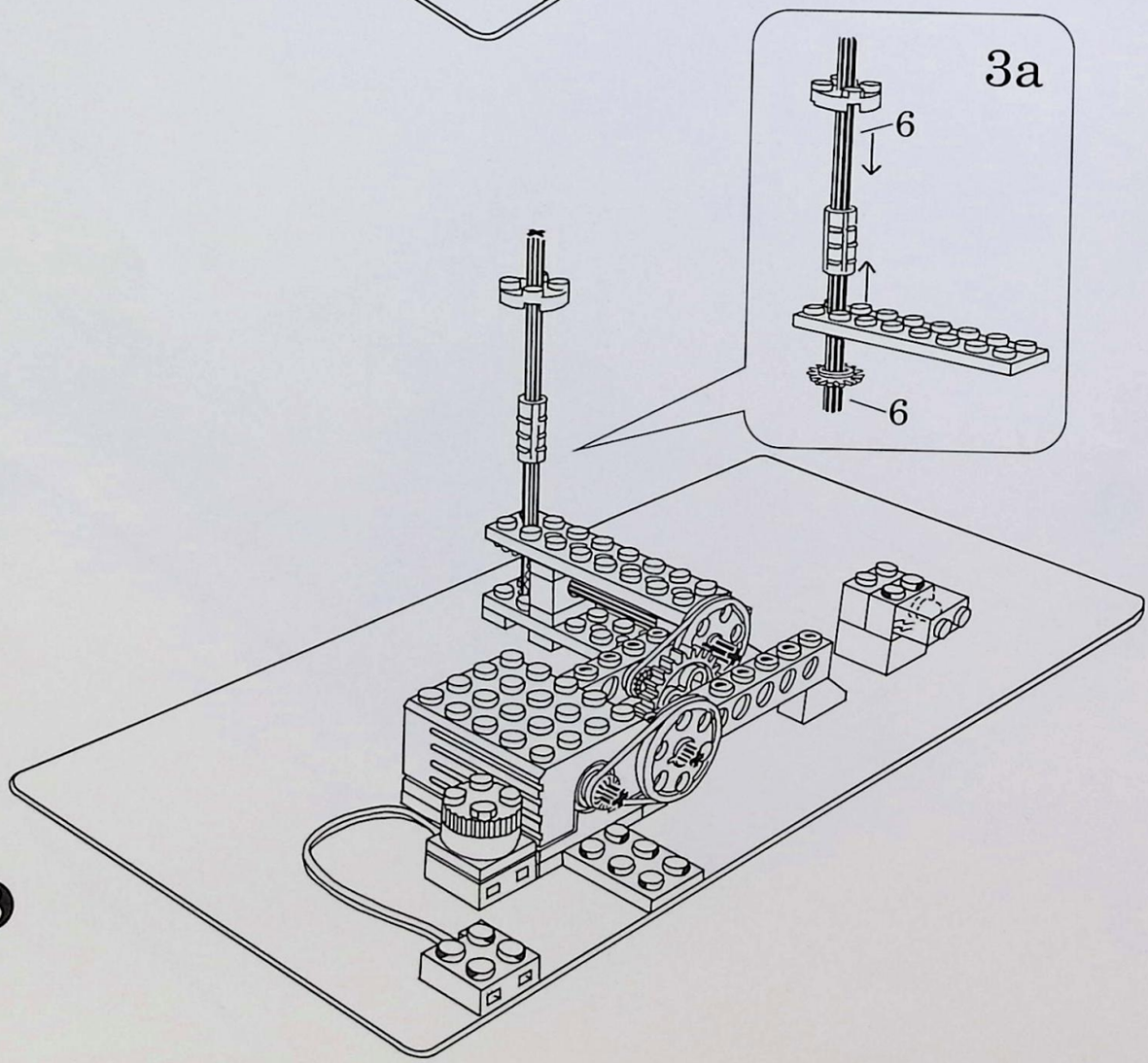

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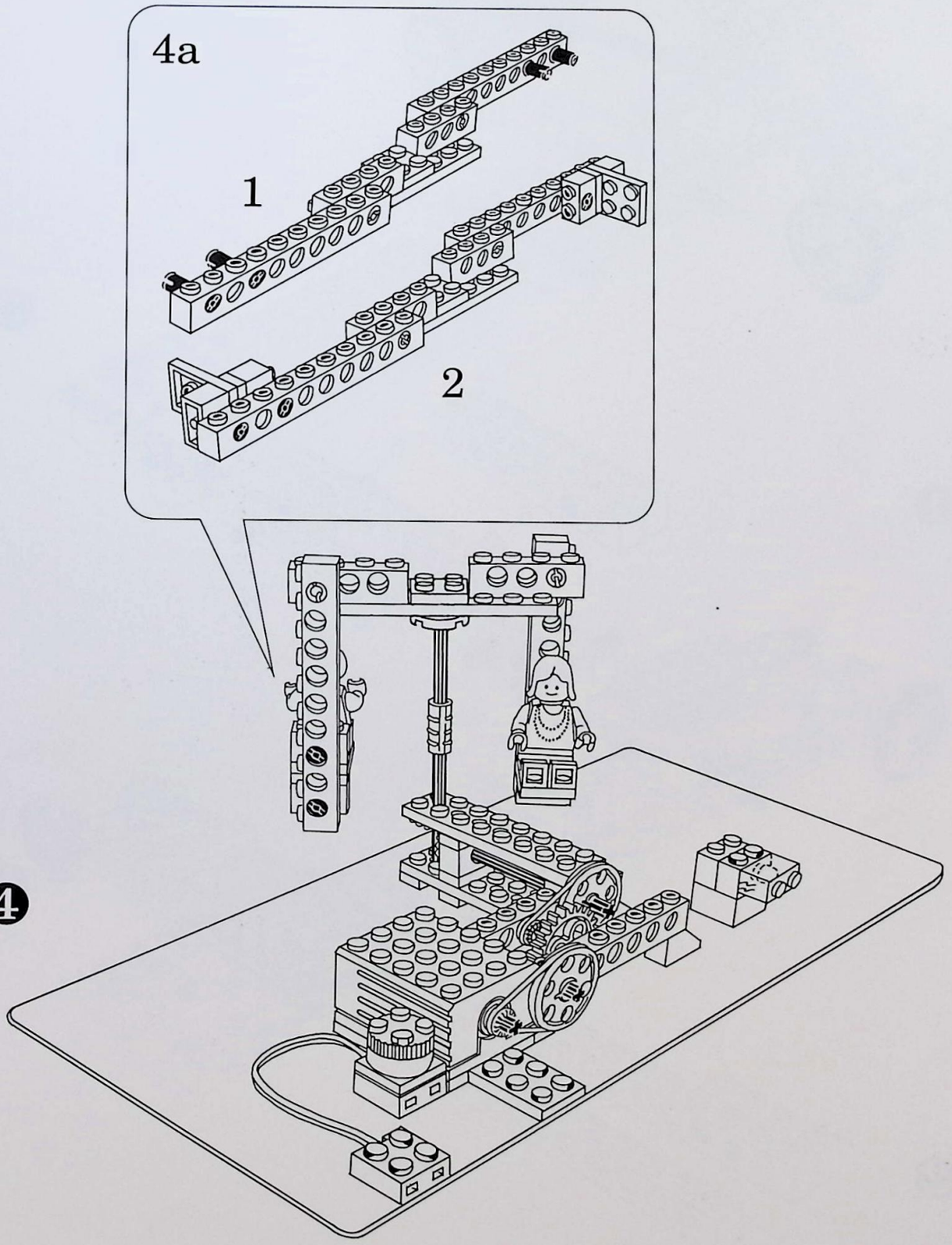

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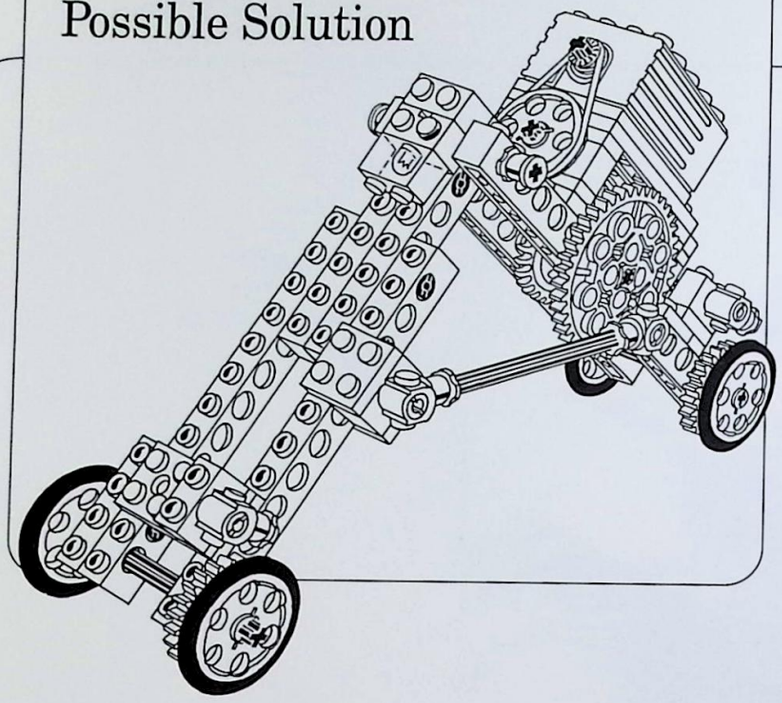
Red Card 4
Possible Solution



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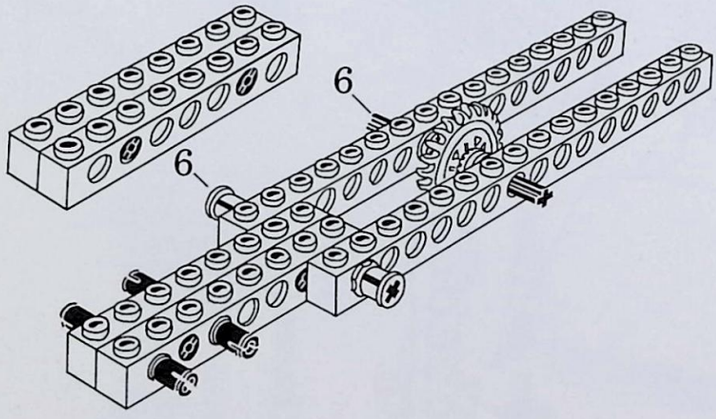

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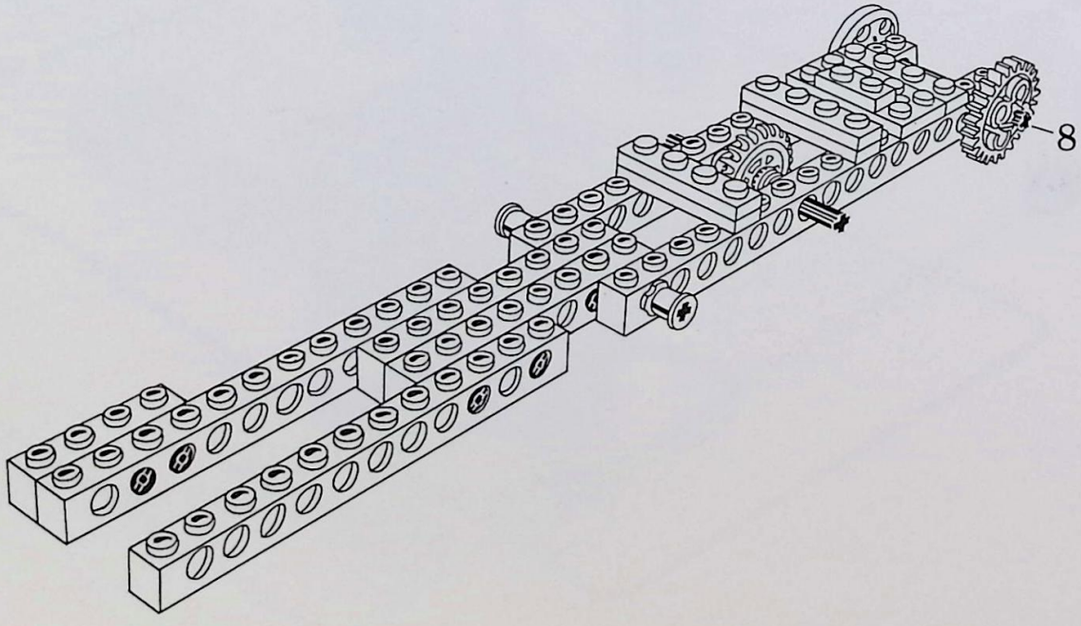

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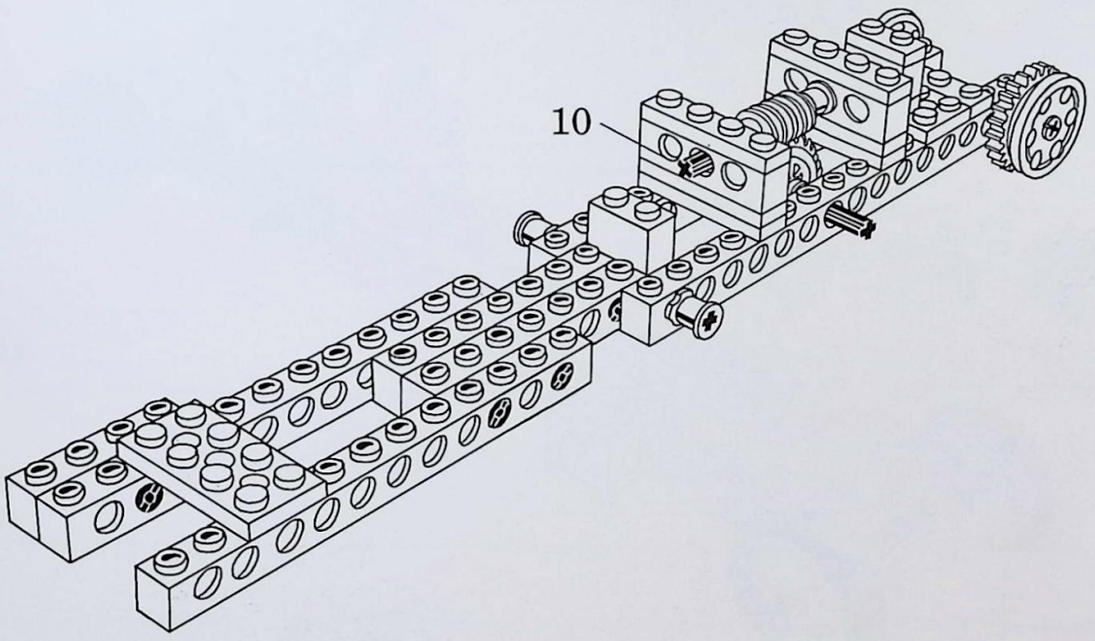

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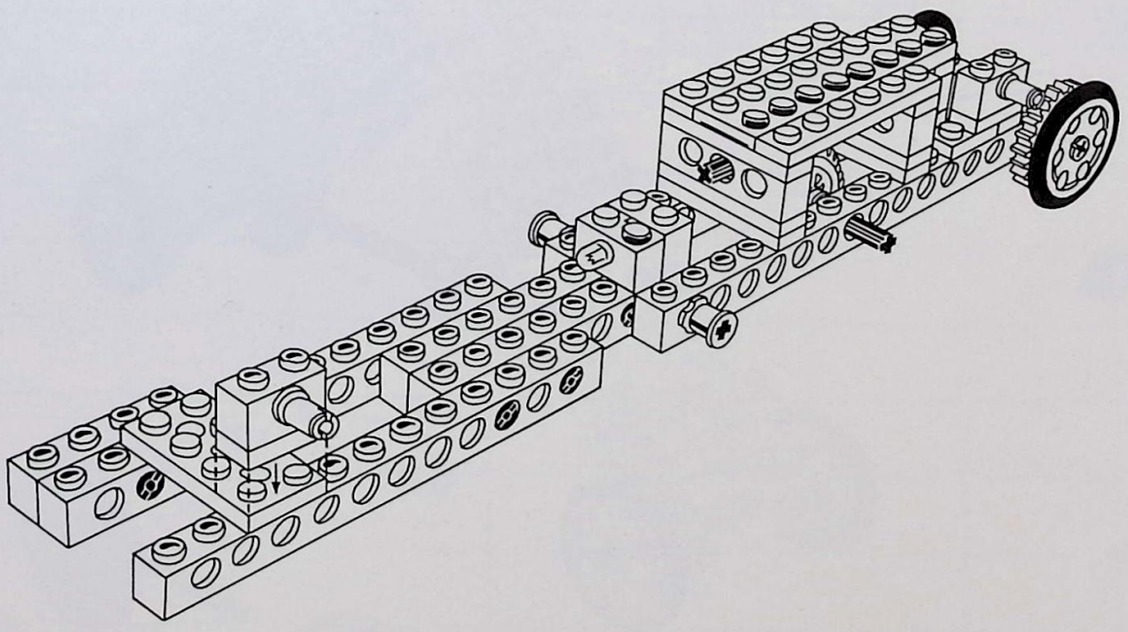

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Red Card 4
Possible Solution

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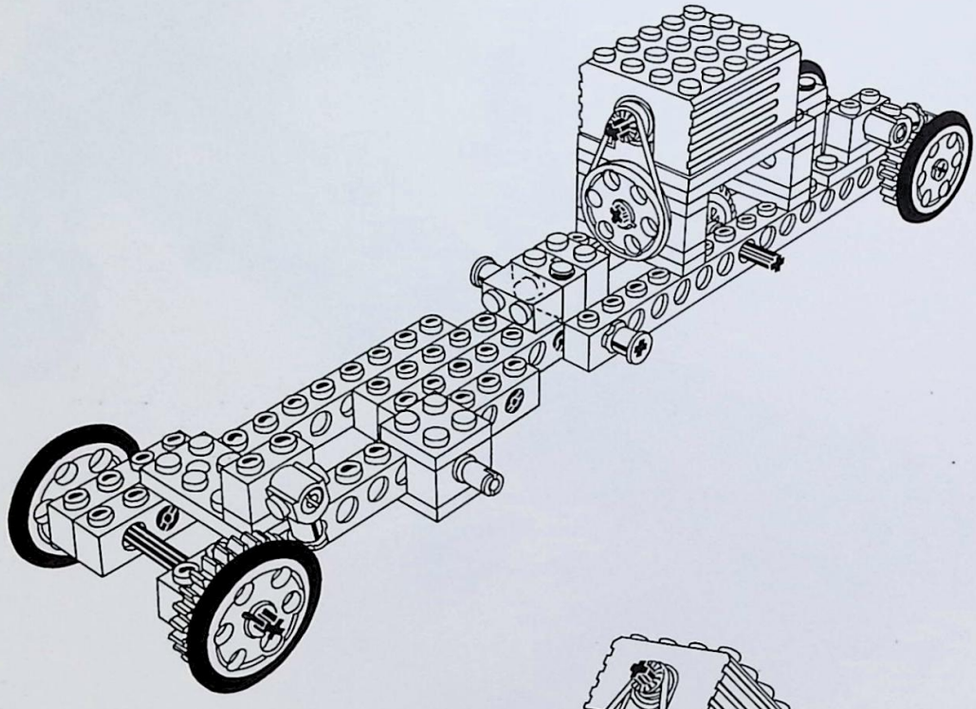

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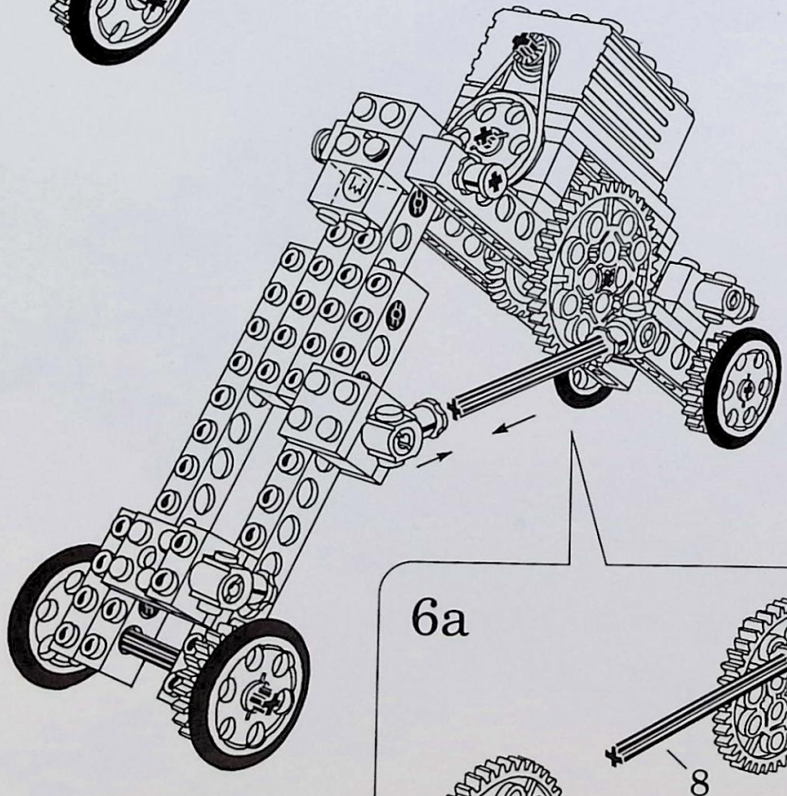

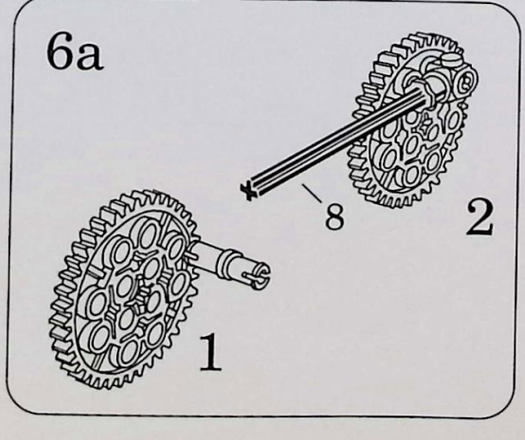

Program Sheet

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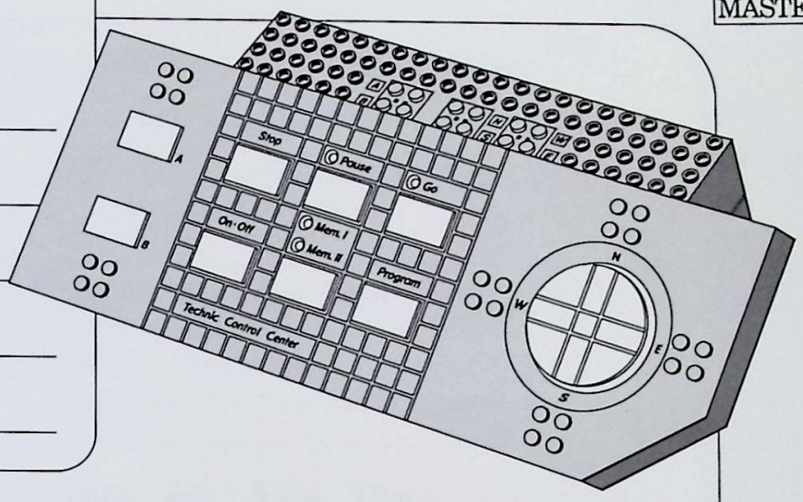
Names

Project

Date

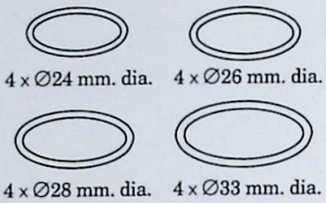


To	PRESS	PRESS	PRESS	SECONDS

Extra Parts

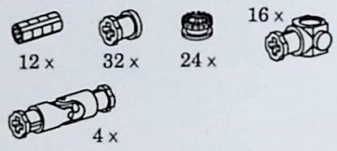
9961

Belts.



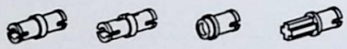
9963

Axle extenders.
Bushings.
Small pulleys.
Piston rods.
Universal joints.



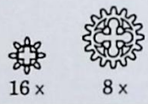
9964

Connector pegs.



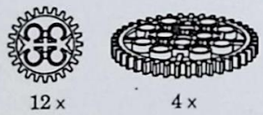
9965

8-tooth gears.
16-tooth gears.



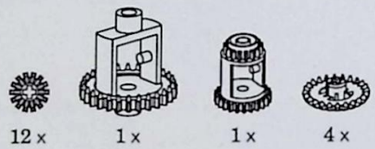
9966

24-tooth gears.
40-tooth gears.



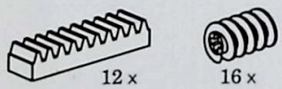
9967

Bevel gears.
Differential housings.
Crown gears.



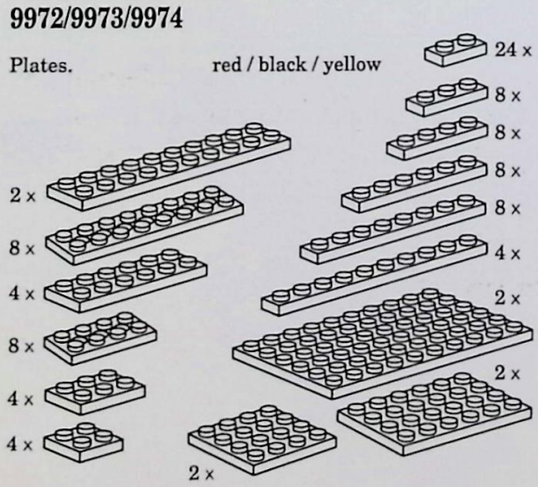
9854

Gear racks.
Worm gears.



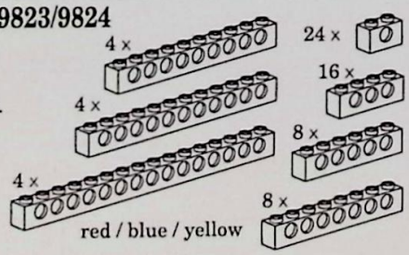
9972/9973/9974

Plates.



9822/9823/9824

Beams.

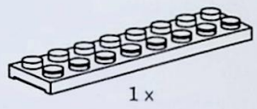


9885

Sound element 9 volt.

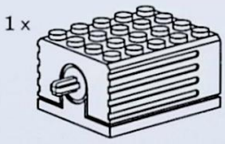
9886

Conducting plate.



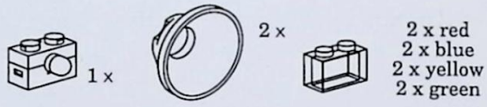
9883

Motor 9 volt.



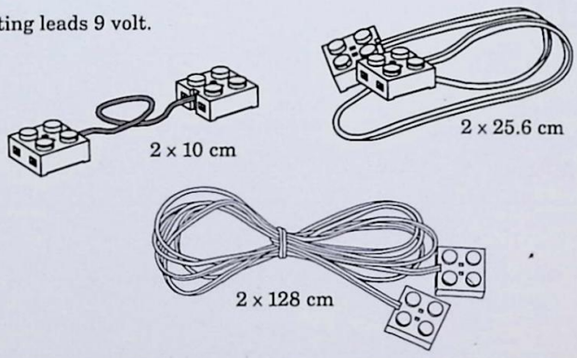
9830

Lamp 9 volt.
Parabolic reflectors.
Translucent bricks.



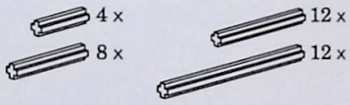
9887

Connecting leads 9 volt.



9970

Short axles.
2 studs long. 4 studs long.
3 studs long. 6 studs long.

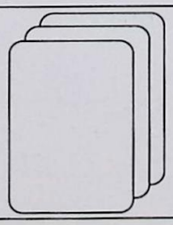


9971

Long axles.
8 studs long.
10 studs long.
12 studs long.

9879

Building cards for Simple Control building set (item #9702)



For a current brochure, write to:

LEGO Dacta
555 Taylor Road, Box 1600
Enfield, CT 06083–1600

LEGO Dacta
LEGO Canada Inc.,
380 Markland Street
Markham, Ontario. L6C 1T6

Glossary

Belt drive: A closed belt or band stretched over two or more rotating pulley wheels to transfer motion.

Bevel gear: A gear with teeth cut at an angle. Bevel gears are used to transfer rotational motion through an angle of 90 degrees.

Circuit: A closed path along which electricity can flow. A typical circuit is set up so that electricity flows from a source of electrical power, such as a battery, along a conductor (wire) to an electrical device, such as a motor or a lamp, and then along another conductor back to the power source.

Conductor: Any material, usually metallic, along which electricity can flow. A piece of copper wire is an example of a conductor.

Connecting lead: A LEGO® element with two 2 x 2 plates joined by two parallel wires. Connecting leads are used to form an electrical circuit between a power source (such as the TECHNIC Control Center) and an electrical device (such as a motor or lamp).

Control buttons: The yellow buttons labeled A and B on the TECHNIC Control Center.

Control pad: The round yellow pad on the TECHNIC Control Center. The control pad is labeled with the letters N, E, S, and W.

Gear: A toothed wheel. Two or more gears can be meshed together to transfer rotational motion.

Insulation: A material, such as plastic or glass, which cannot conduct electricity. The rubber or plastic coating on an extension cord is an example of an insulator.

Memory: The part of the TECHNIC Control Center which retains information about how the control buttons and control pad have been pushed. The TECHNIC Control Center has two separate memories and is able to remember two different programs.

Program: A sequence of information or instructions. The TECHNIC Control Center can run a program to repeat a series of movements, flashes of light, or sound bursts.

Pulley wheel: A grooved wheel. Pulley wheels are used in belt drives as well as in fixed pulley applications such as elevators.

Terminal: A connection for a connecting lead or other electrical device. The TECHNIC Control Center has three terminals, colored yellow, red, and blue.

Worm gear: A threaded shaft which can mesh with a gear wheel.

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107817-USA/CDN.